8. Troubleshooting

Issue 1 06/01
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AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments
	06/01	OJuntunen	

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Introduction

This document is intend to be a guide for localizing and repairing electrical faults in the RAE–3 device. First there is a brief guide for fault localizing. Then fault repairing is divided into troubleshooting paths.

Before any service operation you must be familiar with the RAE-3 product and module level architecture. You must also be familiar with the RAE-3 specified service tools such as the WinTesla service software, Flashing tools and software. Basic skills of using RF measurement devices are required when starting to follow the RF troubleshooting paths.

RAE–3 System HW / UI Troubleshooting

Tools needed for troubleshooting:

- Service tools defined in RAE–3 manual “Service Tools” section
- Laboratory power supply with current indicator
- Oscilloscope
- Digital multimeter . .

General guidelines

General notes about the RAE–3 product:

- RAE–3 has only one common engine – BL8 system HW, ... comprising CMT (phone) and PDA (computer)
- There are separate CMT and PDA displays and keyboards
- CMT display/keyboard and PDA display are on the UI module DL2
- PDA QWERTY–keyboard UI is on UL8 flex module
- Audio connections for the handsfree speaker and earpiece are . . . . . on the UL8 flex module

When you have a faulty RAE-3 device and you start to troubleshoot it, check first the following items:

- If the RAE-3 cannot be turned on by any means, see ”dead . . . . . device” troubleshooting
- Blinking CMT display means that a memory fault is preventing . . . . . normal boot up (–> Memory tests)
- Current consumption (missing consumption) gives an idea . . . . . whether the device able to start up
- Dropping supply voltage indicates a short circuit
- Check whether the connection with Wintesla works and what can . . . . . be discovered with Wintesla
- Check self tests with Wintesla if ”CONTACT SERVICE” is shown . . . . . on the CMT display

- Check visual display faults
- Check that all connectors make good contacts

– this might be the problem if the displays are dark or partially dark or if there are keyboard problems.

Locate failed module (BL8, UL8, DL2) with the MJS–14 test jig. This is the basis of further troubleshooting.

- Check the failed module(s) visually:

– mechanical damages?

– solder joints OK?

Continue with the specific troubleshooting procedure for the module:

- If there is an obvious fault, repair it before reflashing the device
- Flash first if a fault is not obvious

– Flashing troubleshooting leads to power checking and serial interface checking if flashing does not start.

– At the beginning of flash programming, all memory interfaces are first tested
– If flashing is aborted and error(s) return, refer to Memory testing section.

Due to CSP packages short–circuits or broken solder joints are not easily seen. If the examined signal seems to be continuously in low or high level, then measure for possible short–circuit to ground (signal low) or to supply voltage (signal high). Note that if a problem is not found from any visible contact/component it can be under the CSPs where the signal is connected.

If there is no short circuit and the signal level is continuously at a low level, then the following faults are possible:

– contact problem in output soldering (output active)
– contact problem in soldering of pin having internal pull–up (tri–stated signals)

Care must be taken when assembling and disassembling the transceiver. Refer to the instructions in this manual. Failure to do this may result in unnecessary damage to the device.

The PDA display must be calibrated after the following actions have been taken:
– RAE–3 has been flashed
– PDA display or DL2 module has been replaced

Note: The last step in service before returning the RAE-3 to the customer is to **set the RTC running time to 10 hours**.

– Service battery BBL-3B does that automatically.
– Always use only the BBL-3B service battery with Wintesla.

System HW / UI Troubleshooting Cases

1. Troubleshooting of System HW/UI is divided to following cases:

..... 1.1 Dead Device
..... 1.2 Keypad problem

2. BL8 System HW related:

..... 2.1 Flash programming troubleshooting
..... 2.2 General Power Checking
..... 2.3 Device does not stay ON
..... 2.4 Charging checking
..... 2.5 Backup Battery
..... 2.6 Accessory Power Output Troubleshooting
..... 2.7 Clocks
..... 2.8 Memory Tests
..... 2.9 Memory Troubleshooting
..... 2.10 Serial Interface Troubleshooting
..... 2.11 CONTACT SERVICE in CMT display
..... 2.12 CCONT Serial interface Troubleshooting
..... 2.13 SIM Card
..... 2.14 Memory Card
..... 2.15 Lid Switch
..... 2.16 Battery Removal Switch troubleshooting
..... 2.17 COBBA Control Interface troubleshooting
..... 2.18 COBBA PCM Interface Troubleshooting
..... 2.19 Audio troubleshooting
..... 2.20 RF Interface
..... 2.21 IR Interface Troubleshooting diagram
..... 2.22 BL8 related Keyboard problems
..... 2.23 BL8 related PDA UI problems
..... 2.24 BL8 related CMT UI problems

3. DL2 UI Related:

..... 3.1 CMT and keypad illumination problems
..... 3.2 CMT LCD Troubleshooting
..... 3.3 No picture on PDA LCD or picture is faulty
..... 3.4 Backlight troubleshooting
..... 3.5 DL2 related keyboard problems

4. UL8 Flex Related:

. . . . . 4.1 Audio troubleshooting
. . . . . 4.2 Display problem
. . . . . 4.3 Battery Removal Switch problem
. . . . . 4.4 UL8 related keyboard problems

Nominal Current Consumption

The following power consumption values (ref.Table 1) are measured from a complete RAE-3.

Vbattery = 3.7 V.

Measured nominal currents are drawn from the main battery.

Measurements have been made with a current proble connected to an oscilloscope.

Table 1. Nominal current consumption in different operating modes

State	CMT OFF	CMT ON	2W Call (TX5)	0.2W Call (TX19)
Lid closed	2.4 mA	5.6 mA	310 mA (Voice call)	120 mA (Voice call)
Lid Open (min. brightness on PDA display)	60 mA (running)	65 mA (running)	365 mA (HF call)	170 mA (HF call)
Lid Open (max. brightness on PDA display)	140 mA (running)	145 mA (running)	445 mA (HF call)	255 mA (HF call)

Identify the failed module (UL8, DL2, BL8) using the MJS–19 jig.

1 System HW / UI Troubleshooting Cases

1.1 Dead Device

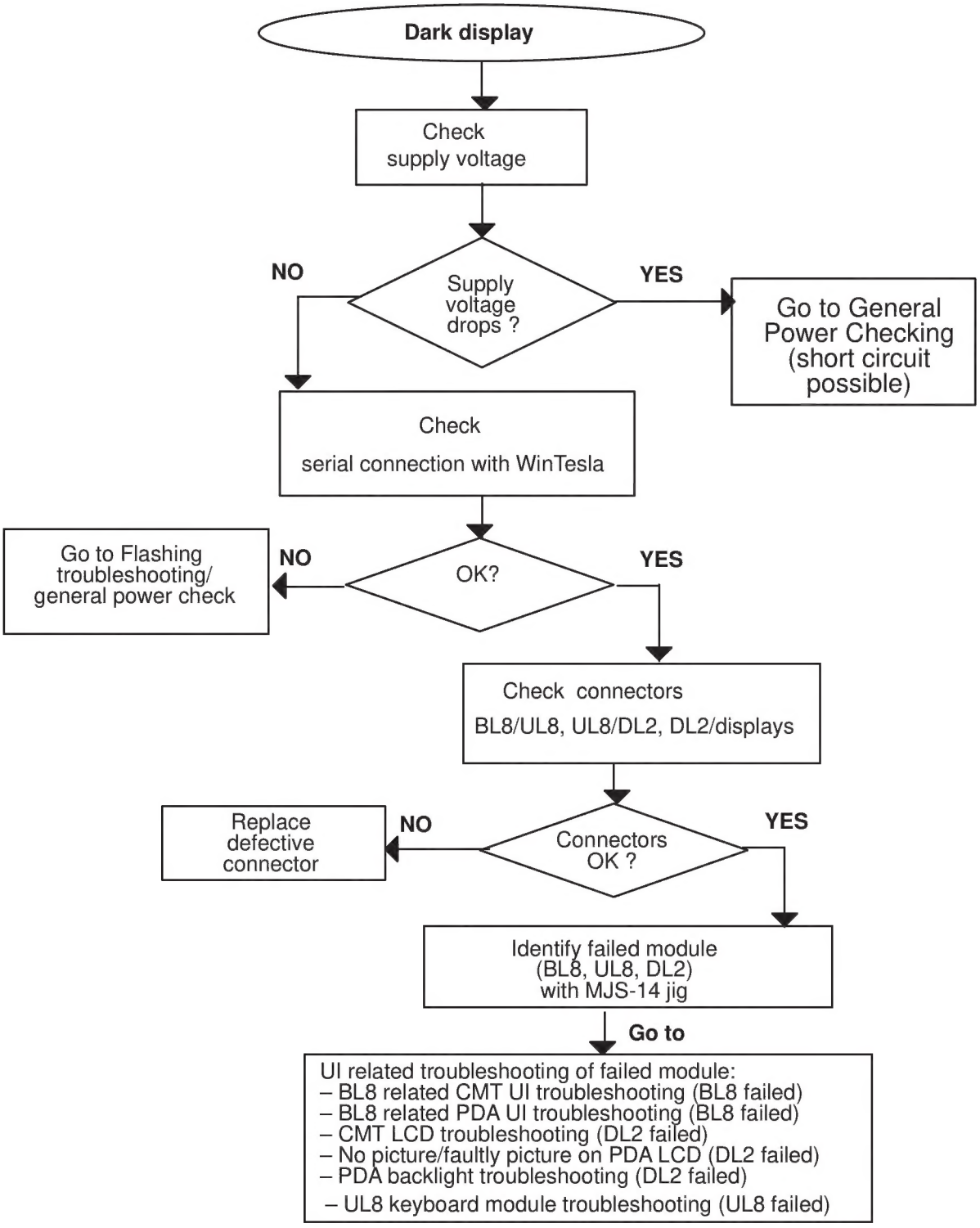

Dark display
Check supply voltage
Supply voltage drops ?
NO
YES
Go to General Power Checking (short circuit possible)
Check serial connection with WinTesla
OK?
NO
YES
Go to Flashing troubleshooting/ general power check
Check connectors BL8/UL8, UL8/DL2, DL2/displays
Connectors OK ?
NO
YES
Replace defective connector
Identify failed module (BL8, UL8, DL2) with MJS-14 jig
Go to
UI related troubleshooting of failed module:
– BL8 related CMT UI troubleshooting (BL8 failed)
– BL8 related PDA UI troubleshooting (BL8 failed)
– CMT LCD troubleshooting (DL2 failed)
– No picture/faultly picture on PDA LCD (DL2 failed)
– PDA backlight troubleshooting (DL2 failed)
– UL8 keyboard module troubleshooting (UL8 failed)

Figure 1.

1.2 Keypad problems

1. Connect the phone under test to Wintesla.

2. Select Testing –> User interface testing

3. Select the CMT to be tested from the "Display" panel and click "Start key test" (figure 1). The test starts and the button text changes to "Stop key test".

4. Click the "Stop key test". Result window (Figure 2) appears.
. . . . . All letters under the key names should show "A".
. . . . . If there is "R", the key is stuck.
Repeat the test. If the result is the same, use table 1 to find out the signals connected to the particular key(s).

5. Click "Start key test" again.
. . . . . This time, press and release all keys through, then stop the test.
. . . . . There should be "P" for every key.
. . . . . If "A" results are seen, repeat and press these keys again. If key presses are not registered, find out the signals connected to the key.

6. Change the keypad to be tested to PDA. Repeat test steps 4 and 5 for the PDA keyboard. The result window is shown in Figure 3.

7. Open the CMT side cover. Check the 50–way connector on UL2.
. . . . . Is it properly inserted, both parts of the connector properly soldered?
Repair, retest

8. Check CMT key mat alignment and membrane switches on the mat. Replace key mat if broken.

9. Check 70–way connector on BL8.
. . . . . Is it properly inserted, both parts of the connector properly soldered?
Repair, retest

10. Locate the faulty part by placing the parts into service jig and changing the parts one by one. Follow instructions in the proper section (2.23 for BL8 fault, 4.4 for UL8 flex fault, 3.5 for UL2 display module fault).

Table 1. Keyboard matrix (keys on UL2 module highlighted) – English keymat

	Col0	**Col1**	**Col2**	**Col3**	**Col4**	**Col5**	**Col6**	**Col7**	**Col8**	**Col9**
Row0	cmt Soft1	cmt Up	cmt Soft2	pda Soft 3	pda Soft 1			Space	Info <	/ >
Row1	cmt Send	cmt Down	cmt End	pda Soft 4	pda Soft 2		Z	Shift	C	B
Row2	cmt 1	cmt 2	cmt 3	cmt Profile	cmt Power		Chr	N	M	, @
Row3	cmt 4	cmt 5	cmt 6	cmt *	cmt #	Menu	Up	Right	Down	Left
Row4	cmt 7	cmt 8	cmt 9	cmt 0		:;	+–	Back-space		Enter
Row5	ESC	App1	App2	App3	app4	App6	App7	App8		
Row6		Ctrl	V	X	6	App5				
Row7	1	2	3	4	5	7	8	9	0	P
Row8	Tab	Q	W	E	R	T	Y	U	I	O
Row9	Caps	A	S	D	F	G	H	J	K	L

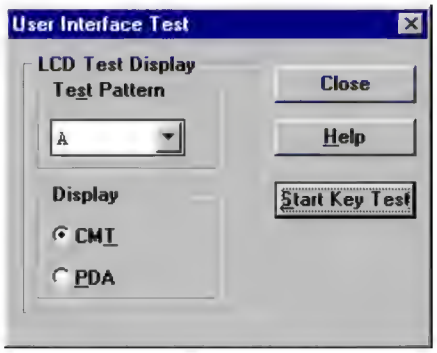


Figure 2. User interface test dialog

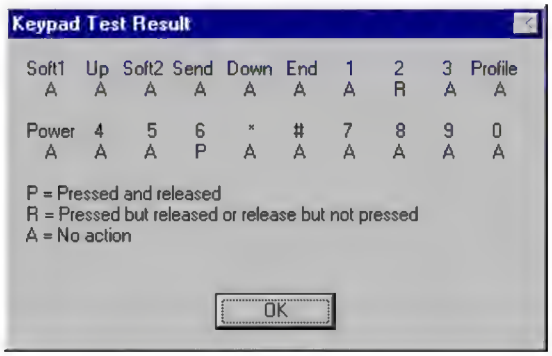

Keypad Test Result
Soft1 Up Soft2 Send Down End 1 2 3 Profile
A A A A A A A R A A
Power 4 5 6 * # 7 8 9 0
A A A P A A A A A A
P = Pressed and released
R = Pressed but released or release but not pressed
A = No action
OK

Figure 3. CMT keypad test results

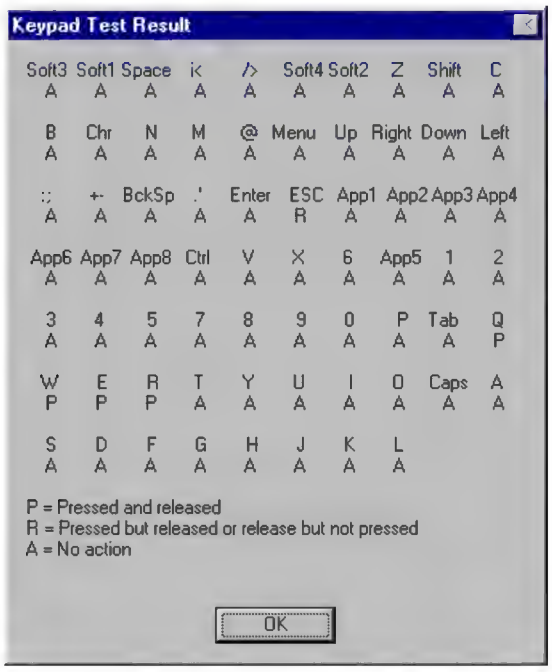

Keypad Test Result
Soft3 Soft1 Space Soft4 Soft2 Z Shift C
A A A A A A A A A A
B Chr N M @ Menu Up Right Down Left
A A A A A A A A A A
Enter ESC App1 App2 App3 App4
A R A A A A
App6 App7 App8 Ctrl V X 6 App5 1 2
A A A A A A A A A A
3 4 5 7 8 9 0 P Tab Q
A A A A A A A A A P
W E R T Y U I O Caps A
P P P A A A A A A A
S D F G H J K L
A A A A A A A A
P = Pressed and released
R = Pressed but released or release but not pressed
A = No action
OK

Figure 4. PDA keypad test results

2 BL8 System HW related

2.1 Flash programming troubleshooting

2.1.1 Flashing does not start

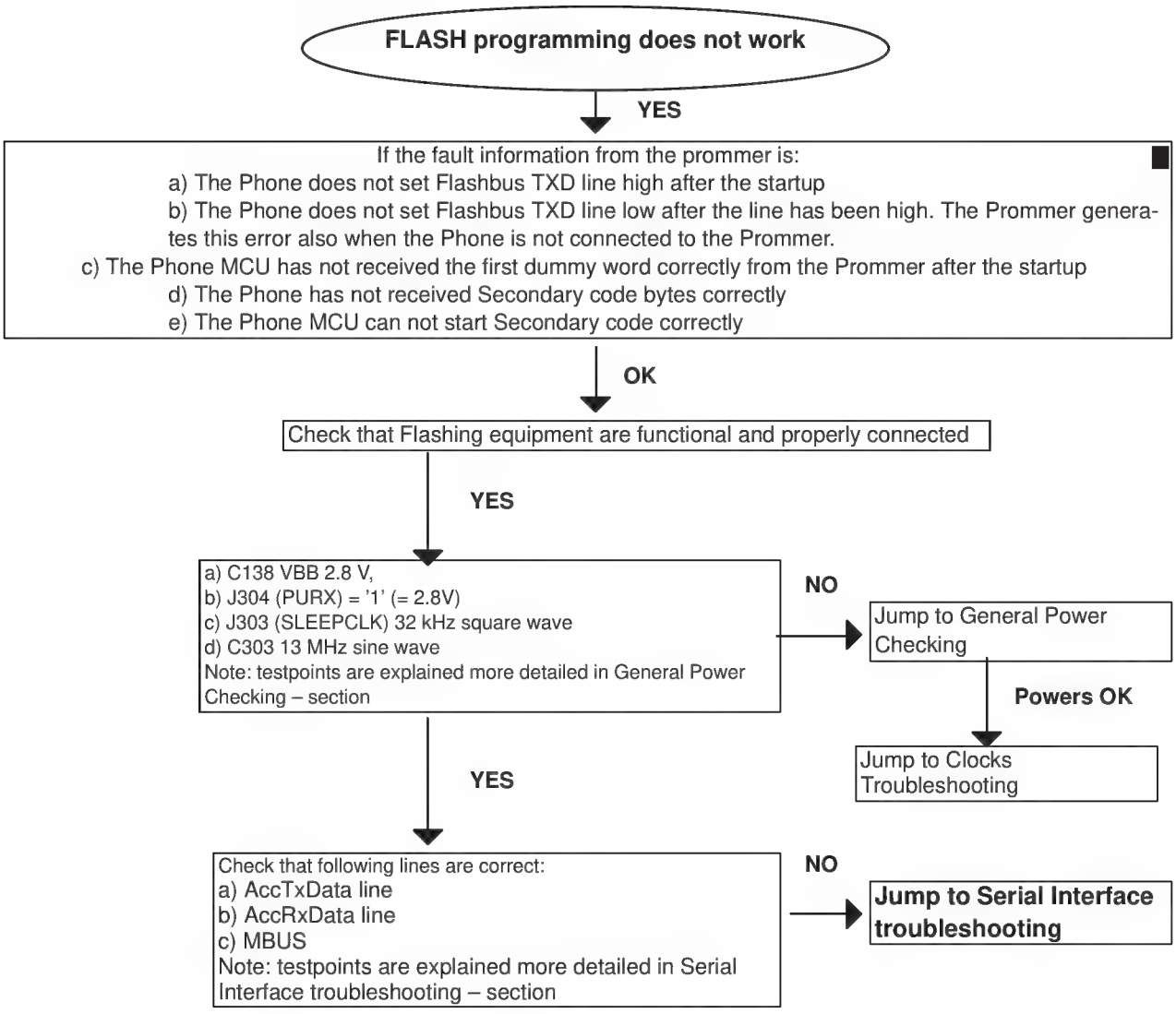

FLASH programming does not work
YES
If the fault information from the prommer is:
a) The Phone does not set Flashbus TXD line high after the startup
b) The Phone does not set Flashbus TXD line low after the line has been high. The Prommer generates this error also when the Phone is not connected to the Prommer.
c) The Phone MCU has not received the first dummy word correctly from the Prommer after the startup
d) The Phone has not received Secondary code bytes correctly
e) The Phone MCU can not start Secondary code correctly
OK
Check that Flashing equipment are functional and properly connected
YES
a) C138 VBB 2.8 V,
b) J304 (PURX) = '1' (= 2.8V)
c) J303 (SLEEPCLK) 32 kHz square wave
d) C303 13 MHz sine wave
Note: testpoints are explained more detailed in General Power Checking – section
NO
Jump to General Power Checking
Powers OK
Jump to Clocks Troubleshooting
YES
Check that following lines are correct:
a) AccTxData line
b) AccRxData line
c) MBUS
Note: testpoints are explained more detailed in Serial Interface troubleshooting – section
NO
Jump to Serial Interface troubleshooting

Figure 5.

YES

2.1.2 Flash memory fault indicated

YES

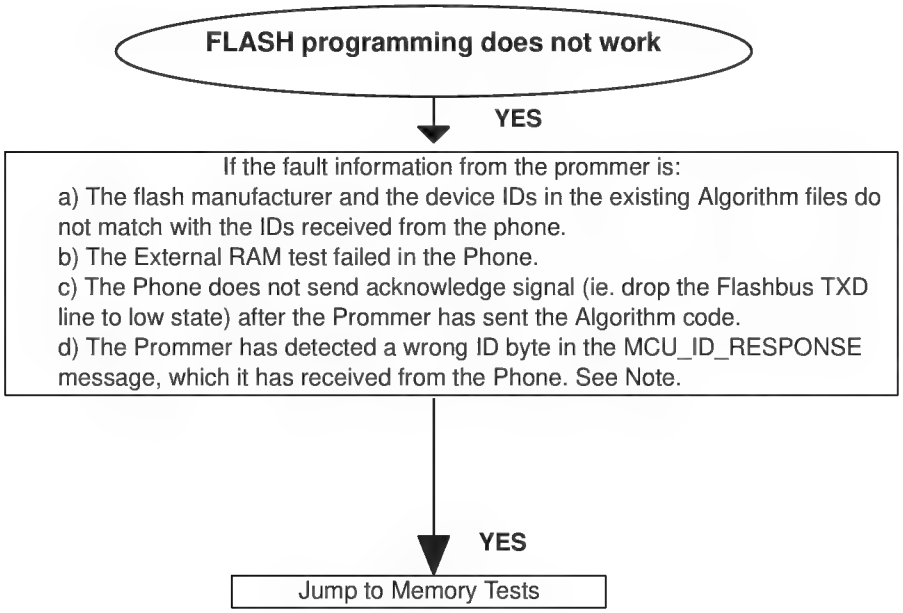

FLASH programming does not work
YES
If the fault information from the prommer is:
a) The flash manufacturer and the device IDs in the existing Algorithm files do not match with the IDs received from the phone.
b) The External RAM test failed in the Phone.
c) The Phone does not send acknowledge signal (ie. drop the Flashbus TXD line to low state) after the Prommer has sent the Algorithm code.
d) The Prommer has detected a wrong ID byte in the MCU_ID_RESPONSE message, which it has received from the Phone. See Note.
YES
Jump to Memory Tests

Figure 6.

Note: Wintesla shows the following Flash ID's for every flash device when programming is going on.

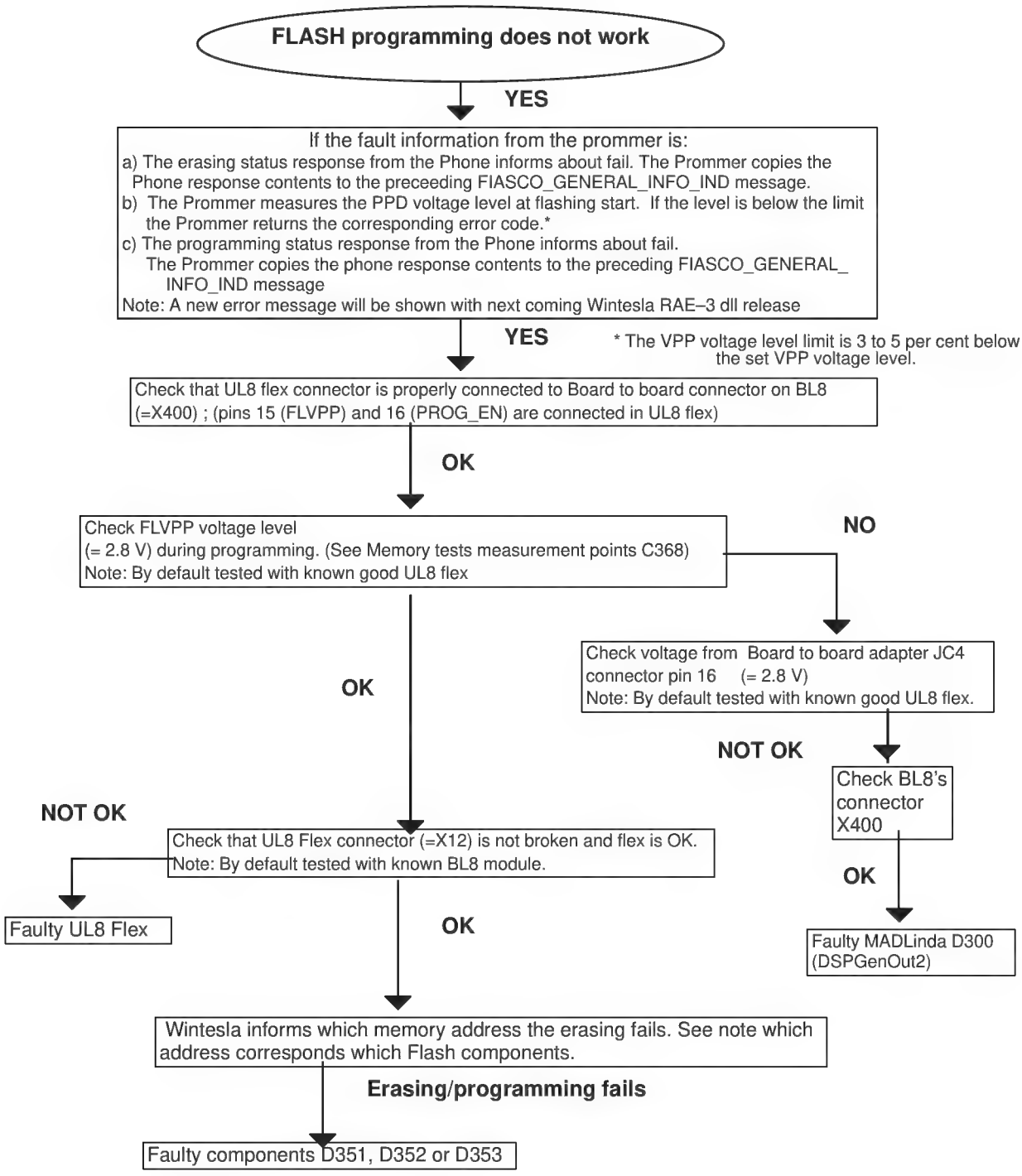
If Flash ID bytes are correct the following bytes are shown:

Flash ID 0089–8896, 0089–8896, 0089–8896, 0000–0030

=Flash 0 =Flash 1 =Flash 2 = SF

But if one or more of Flash ID bytes is/are wrong the Flash is faulty or there is short circuit in the flash interface.

2.1.3 Flash VPP Error


FLASH programming does not work
YES
If the fault information from the prommer is:
a) The erasing status response from the Phone informs about fail. The Prommer copies the Phone response contents to the preceeding FIASCO_GENERAL_INFO_IND message.
b) The Prommer measures the PPD voltage level at flashing start. If the level is below the limit the Prommer returns the corresponding error code.*
c) The programming status response from the Phone informs about fail. The Prommer copies the phone response contents to the preceding FIASCO_GENERAL_ INFO_IND message
Note: A new error message will be shown with next coming Wintesla RAE–3 dll release
YES
* The VPP voltage level limit is 3 to 5 per cent below the set VPP voltage level.
Check that UL8 flex connector is properly connected to Board to board connector on BL8 (=X400) ; (pins 15 (FLVPP) and 16 (PROG_EN) are connected in UL8 flex)
OK
Check FLVPP voltage level (= 2.8 V) during programming. (See Memory tests measurement points C368)
Note: By default tested with known good UL8 flex
NO
OK
Check voltage from Board to board adapter JC4 connector pin 16 (= 2.8 V)
Note: By default tested with known good UL8 flex.
NOT OK
Check BL8's connector X400
OK
Faulty MADLinda D300 (DSPGenOut2)
NOT OK
Check that UL8 Flex connector (=X12) is not broken and flex is OK.
Note: By default tested with known BL8 module.
Faulty UL8 Flex
OK
Wintesla informs which memory address the erasing fails. See note which address corresponds which Flash components.
Erasing/programming fails
Faulty components D351, D352 or D353

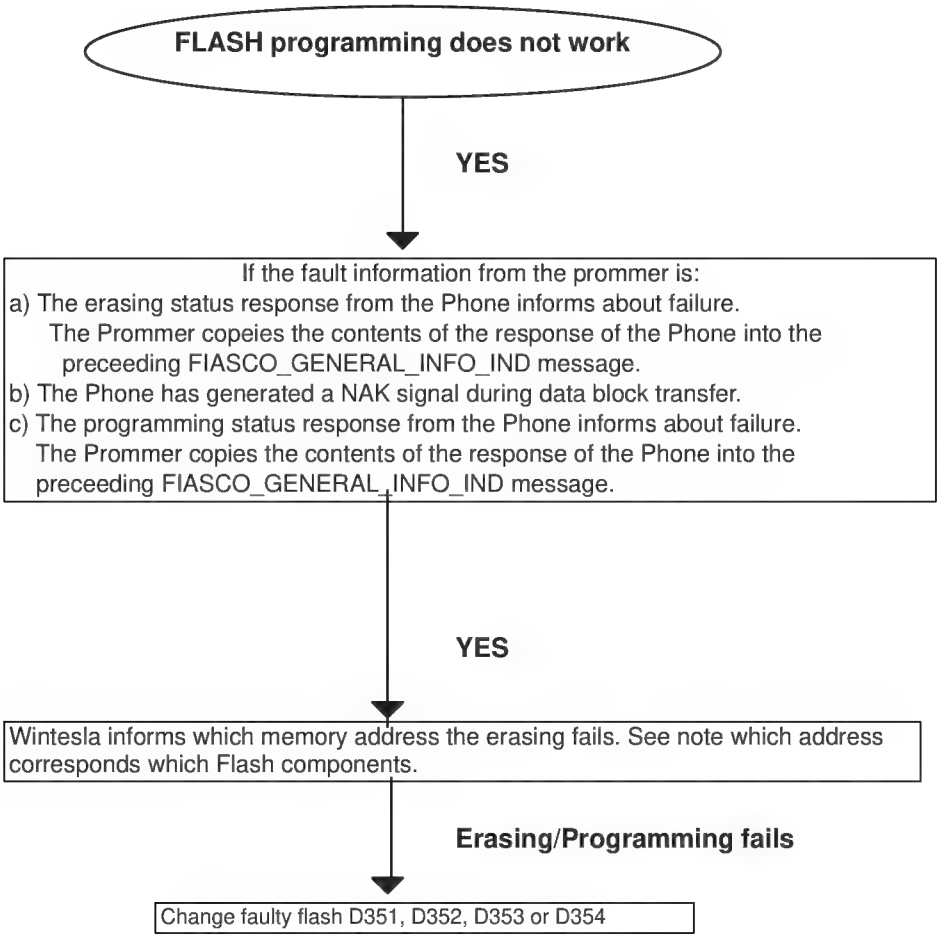
Note:
Flash 0 (=D351) erasing area starts 0x00000000
Flash 0 (=D351) erasing area stops 0x003FFFFF

Flash 1 (=D352) erasing area starts 0x01000000
Flash 1 (=D352) erasing area stops 0x013FFFFF

Note:
Flash 2 (=D353) erasing area starts 0x02000000
Flash 2 (=D353) erasing area stops 0x023FFFFF
Serial Flash (=D354) erasing area starts 0x8000000
Serial Flash (=D354) erasing area stops 0x841FFFF

Figure 7.

2.1.4 Flash Erasing /Programming Error


FLASH programming does not work
YES
If the fault information from the prommer is:
a) The erasing status response from the Phone informs about failure.
The Prommer copeies the contents of the response of the Phone into the preceeding FIASCO_GENERAL_INFO_IND message.
b) The Phone has generated a NAK signal during data block transfer.
c) The programming status response from the Phone informs about failure.
The Prommer copies the contents of the response of the Phone into the preceeding FIASCO_GENERAL_INFO_IND message.
YES
Wintesla informs which memory address the erasing fails. See note which address corresponds which Flash components.
Erasing/Programming fails
Change faulty flash D351, D352, D353 or D354

Note:
Flash 0 (=D351) erasing area starts 0x00000000
Flash 0 (=D351) erasing area stops 0x003FFFFF

Flash 1 (=D352) erasing area starts 0x01000000
Flash 1 (=D352) erasing area stops 0x013FFFFF
Flash 2 (=D353) erasing area starts 0x02000000
Flash 2 (=D353) erasing area stops 0x023FFFFF
Serial Flash (=D3534 erasing area starts 0x8000000
Serial Flash (=D3534 erasing area stops 0x841FFFF

Figure 8.

2.2 General Power Checking

Use BBL-3B service battery. Battery voltage must be 3.7 V.

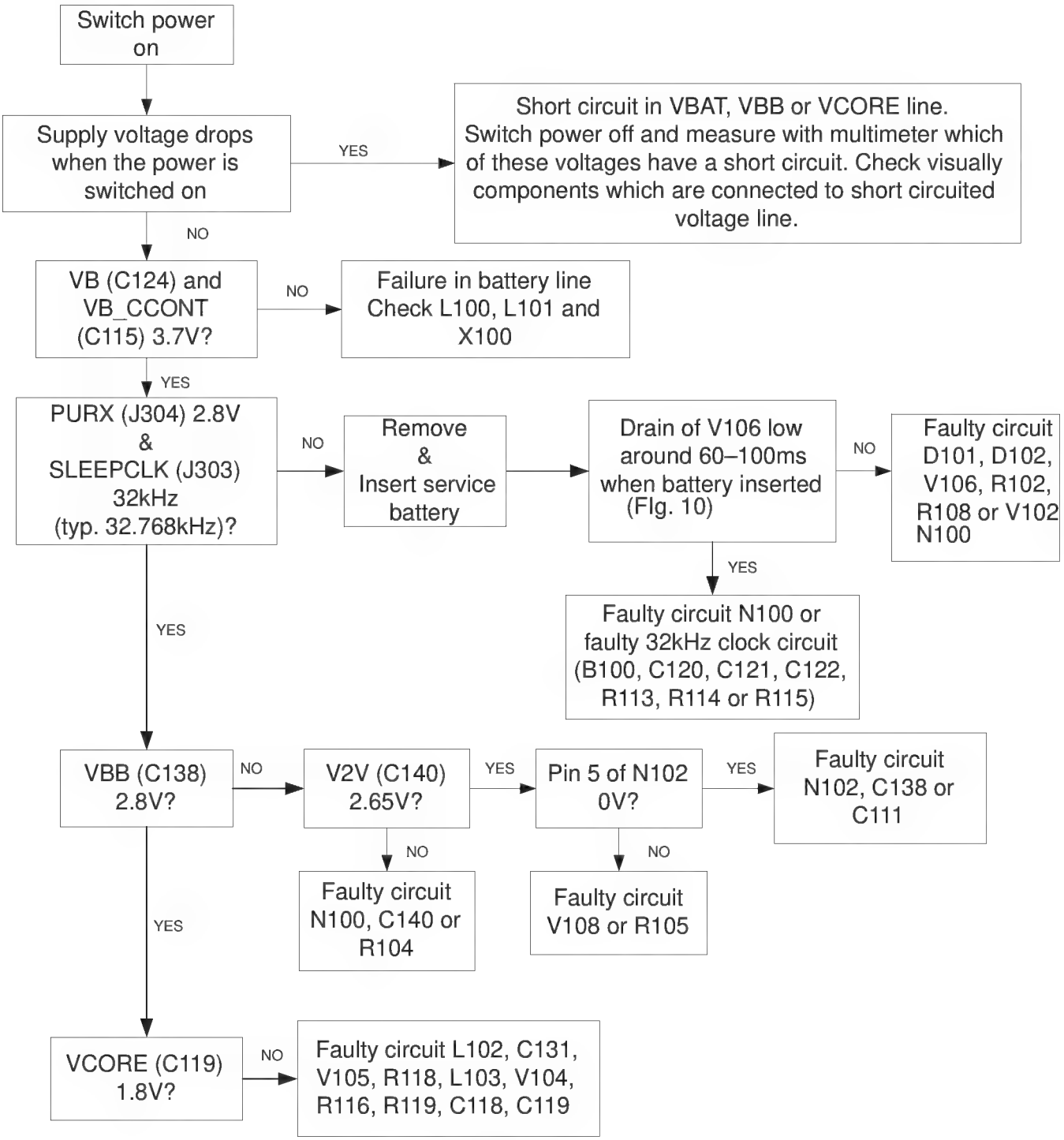

Switch power on
Supply voltage drops when the power is switched on
YES
Short circuit in VBAT, VBB or VCORE line. Switch power off and measure with multimeter which of these voltages have a short circuit. Check visually components which are connected to short circuited voltage line.
NO
VB (C124) and VB_CCONT (C115) 3.7V?
NO
Failure in battery line Check L100, L101 and X100
YES
PURX (J304) 2.8V & SLEEPCLK (J303) 32kHz (typ. 32.768kHz)?
NO
Remove & Insert service battery
Drain of V106 low around 60–100ms when battery inserted (Flg. 10)
NO
Faulty circuit D101, D102, V106, R102, R108 or V102 N100
YES
Faulty circuit N100 or faulty 32kHz clock circuit (B100, C120, C121, C122, R113, R114 or R115)
YES
VBB (C138) 2.8V?
NO
V2V (C140) 2.65V?
YES
Pin 5 of N102 0V?
YES
Faulty circuit N102, C138 or C111
NO
Faulty circuit N100, C140 or R104
NO
Faulty circuit V108 or R105
YES
VCORE (C119) 1.8V?
NO
Faulty circuit L102, C131, V105, R118, L103, V104, R116, R119, C118, C119

Figure 9.

Oscilloscope screen shot (Figure 10) .

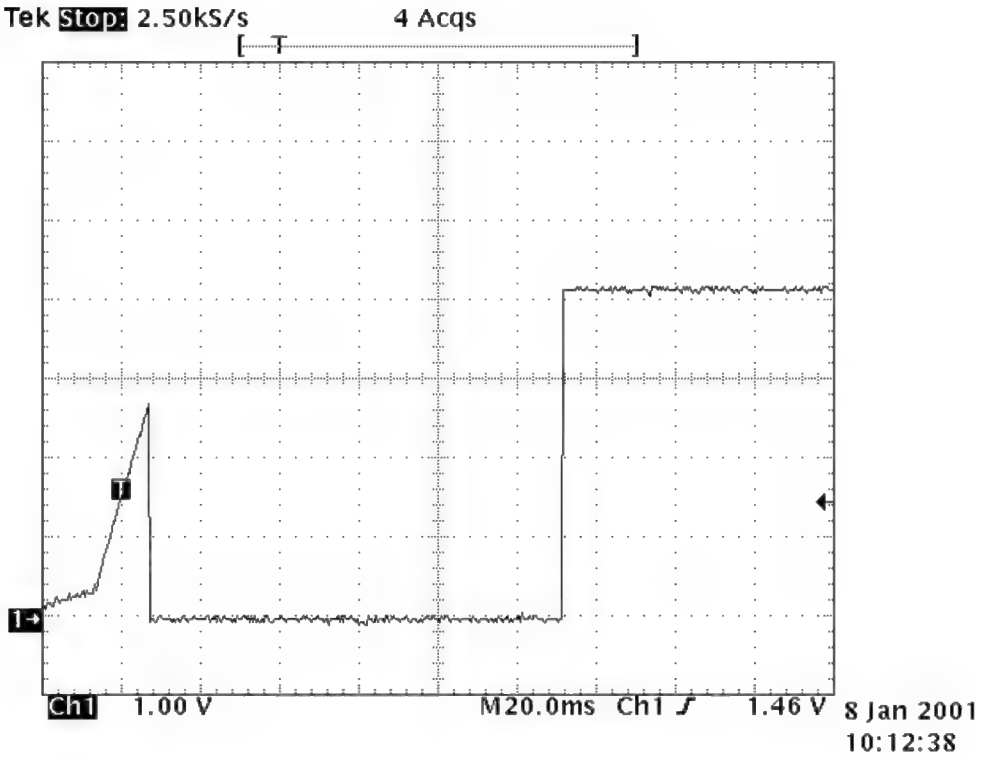


Figure 10. Drain of V106 when battery is inserted

2.3 Device does not stay ON

If the device is switched off without any visible reason, there may be problems in the following areas:

- CCONT watch dog problem
- BSI or BTEMP line problem
- Battery line problem
- Soldering problem

The most likely reason is CCONT WD (watchdog) problem, which turns the device off after about 32 s.

This may be caused by SW problem, MadLinda problem, CCONT problem or memory problems.

The following tests are recommended:

- General Power Checking
- Clocks
- Memory testing
- CCONT serial interface

If there is something wrong in BSI and BTEMP lines, the device seems to be dead after battery insertion. However, the regulators in the device are on 10s before the powerdown.

This mode can easily be detected from the current consumption of the device. After 10s the current consumption drops almost to 0mA.

In this case check components
C126, C127
R121, R122, R123,
C103, C104,
battery connector X100.

2.4 Charging checking

Use the BLL–3 battery and the JBE-2 calibration unit to test charging.
When you are charging totally empty battery, remember that start–up charging might take 2 minutes with ACP–9 charger and several minutes with ACP–7 charger.
During this time display is blank. If charger is not NMP approved type and supported by phone then the software doesn't start charging and display 'NOT CHARGING'.
Remove and reconnect battery and charger few times before you start to measure module. This check ensures if module fault really exists.

See the diagram Figure 11 next page.

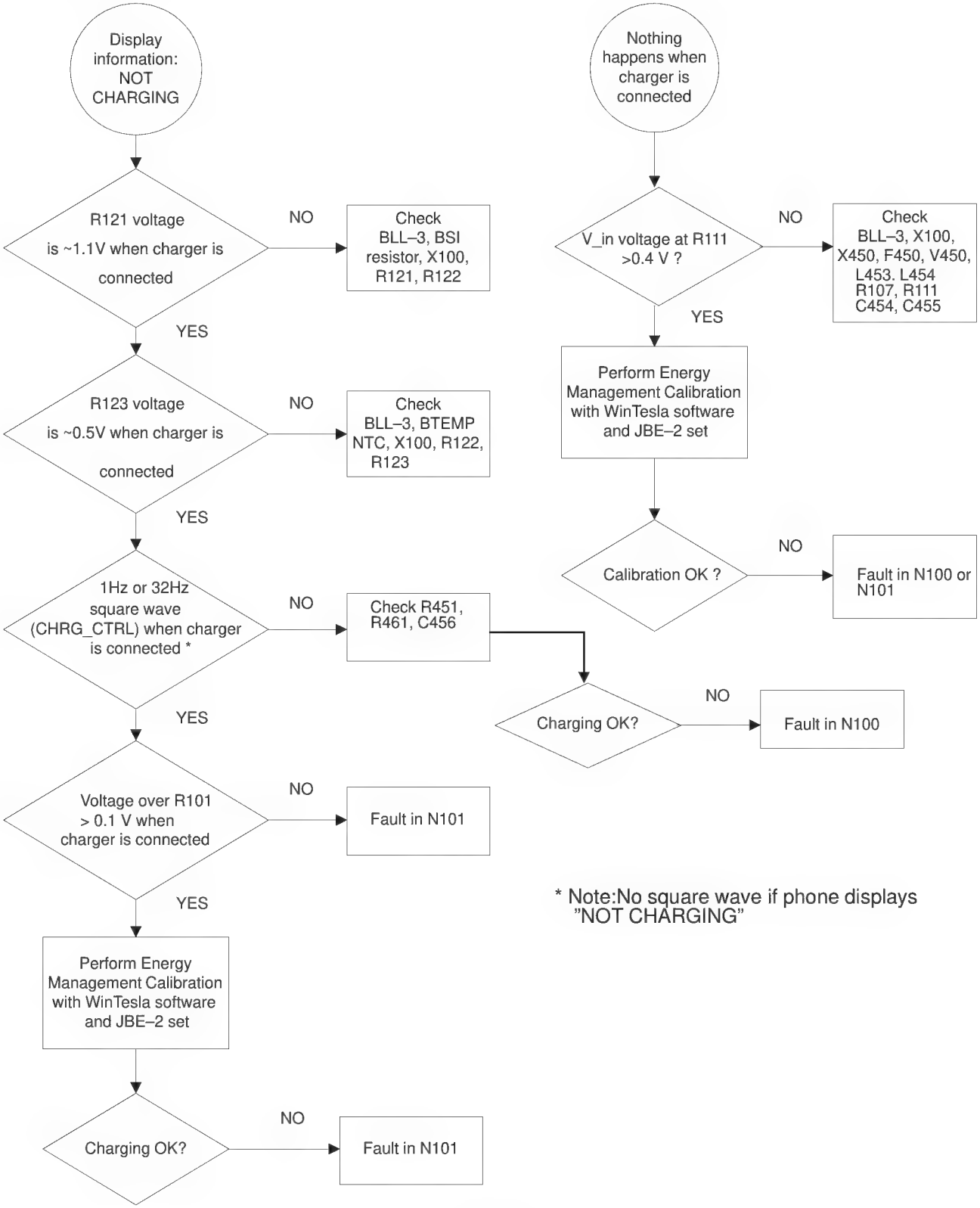

Display information: NOT CHARGING
R121 voltage is ~1.1V when charger is connected
NO
Check BLL–3, BSI resistor, X100, R121, R122
YES
R123 voltage is ~0.5V when charger is connected
NO
Check BLL–3, BTEMP NTC, X100, R122, R123
YES
1Hz or 32Hz square wave (CHRG_CTRL) when charger is connected *
NO
Check R451, R461, C456
YES
Voltage over R101 > 0.1 V when charger is connected
NO
Fault in N101
YES
Perform Energy Management Calibration with WinTesla software and JBE–2 set
Charging OK?
NO
Fault in N101
Nothing happens when charger is connected
V_in voltage at R111 >0.4 V ?
NO
Check BLL–3, X100, X450, F450, V450, L453. L454 R107, R111 C454, C455
YES
Perform Energy Management Calibration with WinTesla software and JBE–2 set
Calibration OK ?
NO
Fault in N100 or N101
Charging OK?
NO
Fault in N100
* Note:No square wave if phone displays "NOT CHARGING"

Figure 11.

2.5 Backup Battery

CAUTION
Danger of explosion if the battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the equipment manufacturer.

Discard used batteries according to the manufacturer's instructions.

Figure 12.

2.5.1 Backup battery troubleshooting

Main power supply to the device must be 3.7 V when used.

Symptom of Backup battery fault is:
Real Time Clock loses the correct time when the main battery is not connected.

The same symptom can also be seen when the backup battery is empty. About one week is needed to fully charge the backup battery in the device.

Always check the backup battery visually for any leakage or any other visual defect.

Check that the backup battery is correctly mounted in the device before closing the cover.

KEEP IN MIND THAT THE BACKUP BATTERY DOES NOT TOLERATE EXCESS HEAT. WHENEVER HEAT BLOWER IS USED, FOR EXAMPLE TO REMOVE COMPONENTS, FIRST REMOVE THE BACKUP BATTERY AND PLACE IT TO ADEQUATE DISTANCE FROM THE WORKING LOCATION.

1. Remove the backup battery.
2. Measure the voltage of the backup battery:

- Normal operation when the voltage is >1.8V.
- Fully charged when voltage is about 3.1V.

3. Connect 3.7V power supply to the device.

4. Check the backup battery connector X102 visually.
5. Measure voltage at terminal 1 of X102.
   It must be 2.82 V to 3.3V.
   –> if NOT OK, then N101 is faulty.
6. Insert the backup battery in the connector, make sure that the contact is good.
7. Measure voltage at terminal 2 of X102.
   It must be 1.8 V to 3.3V. This voltage increases because of charging if the battery is not fully charged.
8. Read the backup battery with WinTesla.
   –> if not OK then N100 is faulty.
9. Ensure that the RTC running time is set to 10 hours setting.
   When the service battery BBL-3B is used, this is set automatically. (See General Guidelines)

2.6 Accessory Power Output Troubleshooting

Accessory power output is connected to the system connector's DCE_DTR pin inside the device.Accessory power output can be tested with MJS–14 test jig and Wintesla SW. There is a pushbutton called ACC VOLTAGE in MJS–14 test jig which is used to connecting load to DCE_DTR pin of the system connector. Following Figure 13 shows the connection in MJS–14 test jig (load side).

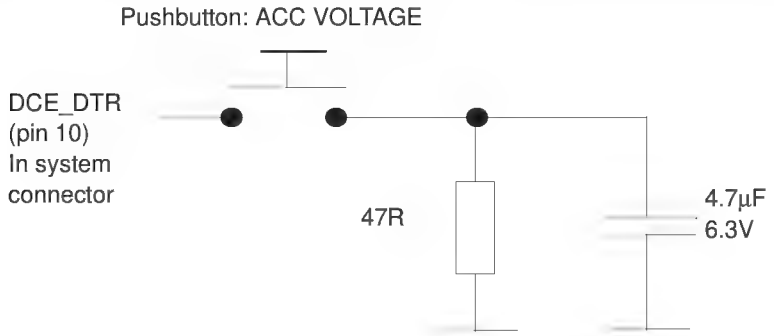


Figure 13. ACC VOLTAGE test configuration in MJS–14 test jig

Figure 13 describes the ACC VOLTAGE test configuration in the MJS–14 test jig. Status of the DTR signal in MADLinda is read by Wintesla SW. Test sequence in use is roughly shown in the following Figure 14:

.

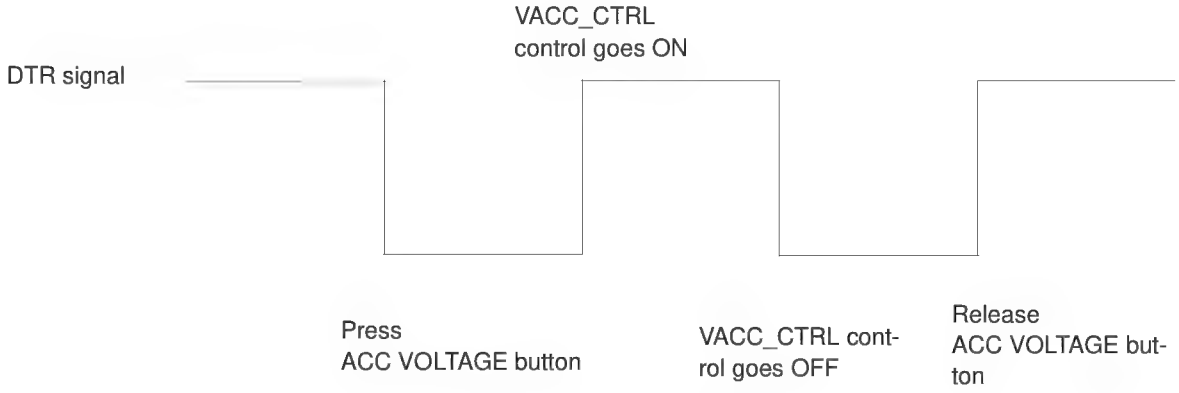


Figure 14. Test sequence

Figure 14 describes the test sequence and status of DTR line during Accessory Power Output Testing . Accessory output voltage test in Wintesla asks the test person to press ACC VOLTAGE button and keep it pressed. After that SW automatically turns ON and OFF the accessory output voltage and gives the passed/fail information. Wintesla SW gives guidance during this test.

2.6.1 No Accessory Voltage when needed

– Power supply must be 3.7V.

– MJS–14 Test Jig must be used.

– Signals must be measured during Wintesla Accessory Power Output Test .

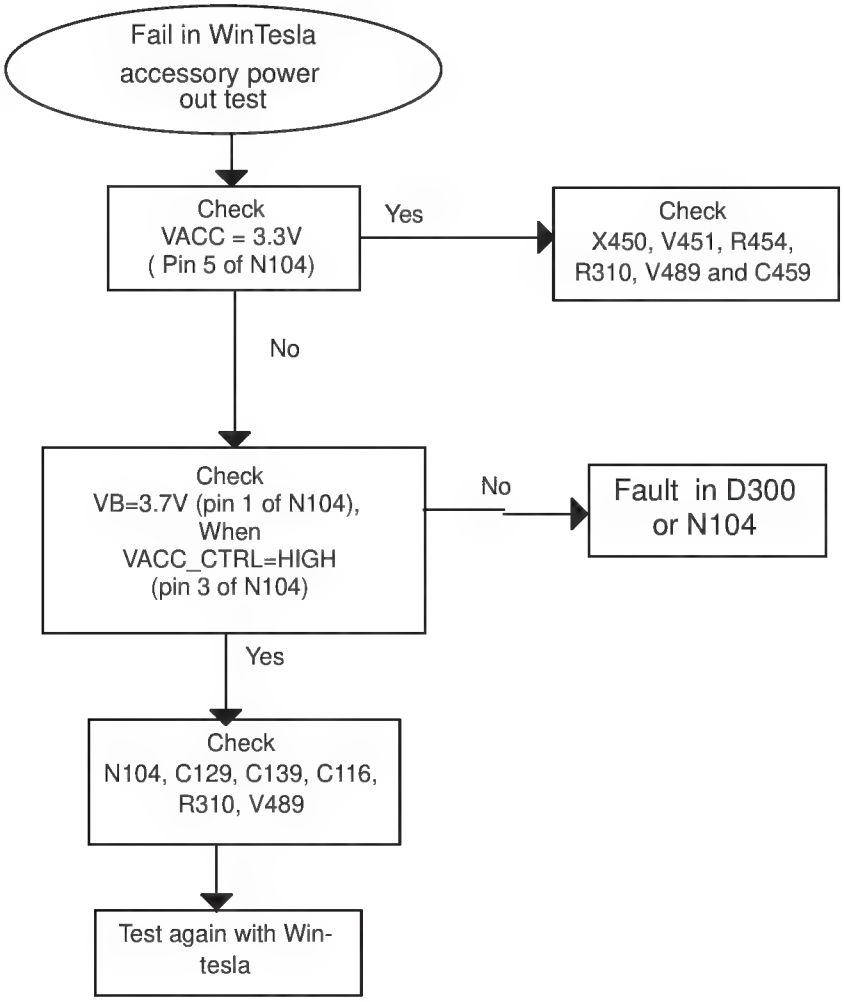

Fail in WinTesla accessory power out test
Check VACC = 3.3V (Pin 5 of N104)
Yes
Check X450, V451, R454, R310, V489 and C459
No
Check VB=3.7V (pin 1 of N104), When VACC_CTRL=HIGH (pin 3 of N104)
No
Fault in D300 or N104
Yes
Check N104, C129, C139, C116, R310, V489
Test again with Win-tesla

Figure 15.

2.6.2 Accessory Voltage ON all the time

– Power supply must be 3.7V.
– MJS–14 Test Jig must be used.
– This fault can be seen also as serial interface problem.
– Signals must be measured during Wintesla Accessory Power Output Test.

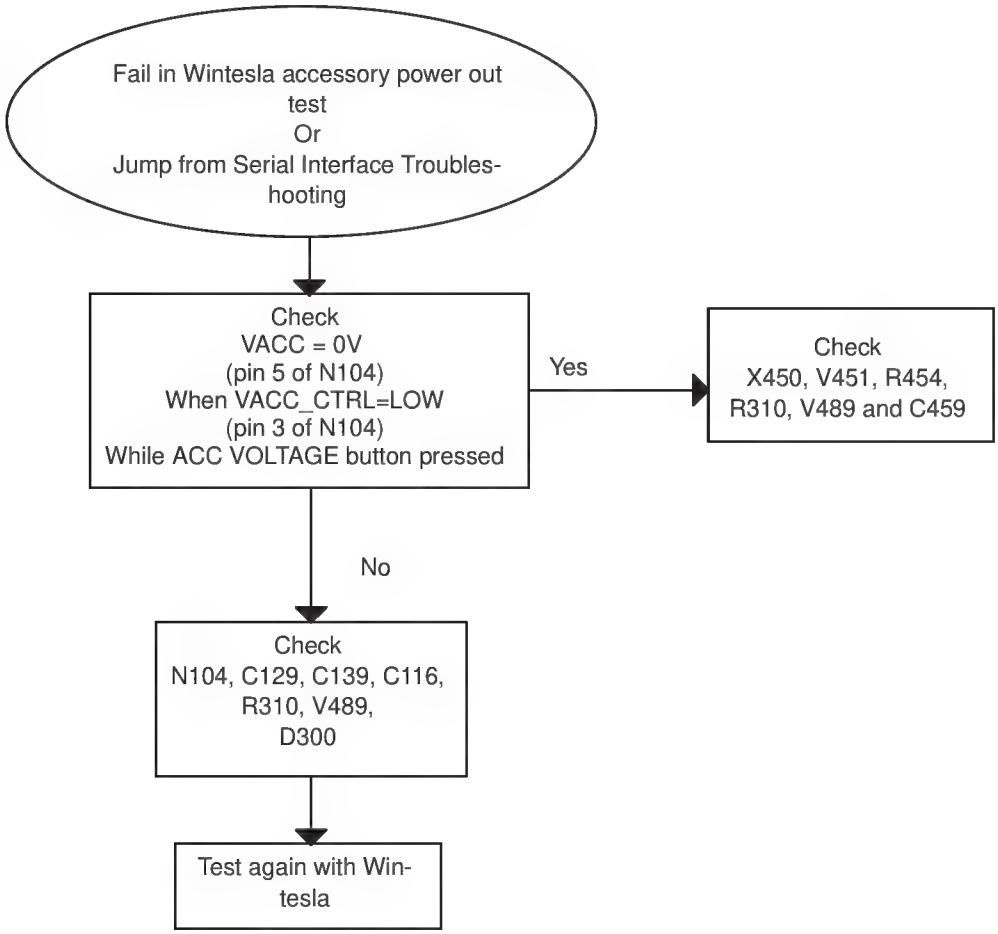


Figure 16.

2.7 Clocks

2.7.1 Clocks Troubleshooting

When the flashing of the device does not succeed, but the powering is OK, follow these instructions.

Note: The absence of clocks may indicate that the device is in sleep mode. Move the magnet away from the sensor to simulate cover open situation.

IMPORTANT: Clock signals must be measured with 1MΩ (or greater) probe! New Tektronix P6249 probes (20kΩ impedance) and similar cannot be used!

1 Measure RFC signal at C303. It should show 13.000 MHz sine wave, approximately 1.2Vp–p with about 950mV DC–offset (see Figure 17). Check the C303 capacitor.

- If this is OK, the processor gets the clock signal. The processor may be faulty, or the fault is in the memories. Continue to ”Memories” section.
- If there is the clock signal, but there is no DC–offset (signal low level around 0V), check the probe used so that it is not loading the signal. If the probe is not responsible for missing DC–offset, try cycling the power a couple of times. If this does not help, the clock slicer circuitry in the MADLinda (D300) is faulty.
- If there is no clock signal at all, continue at 2.

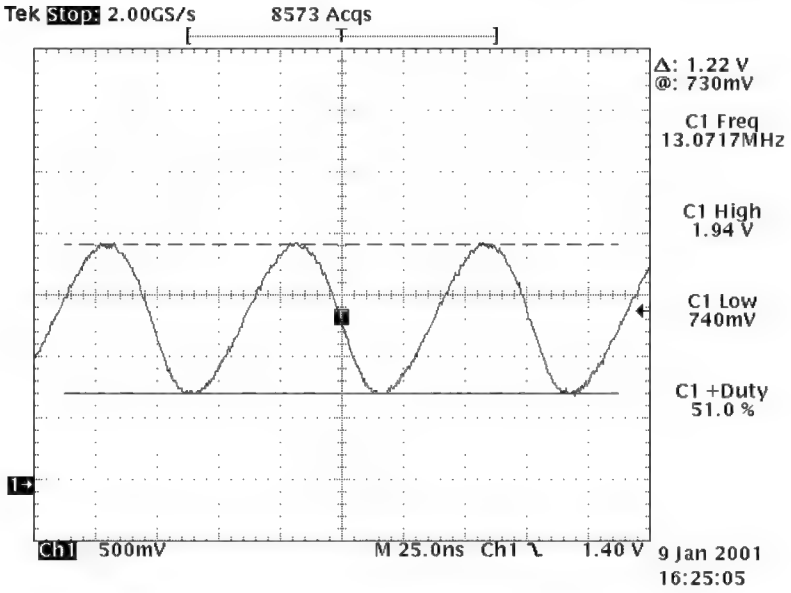


Figure 17. Clock signal

2. Check VXO power line at C553. It should be around 2.8V. If it is, move to 4.

3. Check VCXOPwr (J302). It should be around 2.8V.

- If it is 2.8V, CCONT (N100) is faulty.
- If VCXOPwr is 0V, MADLinda (D300) has shut down the regulators (sleep) or it is faulty. Cycle the power and re–check.

1. Open the smaller RF shield metal can. Check Hagar RFC–out signal at V800. It should show sine wave of 1.2V amplitude, 13MHz frequency (see Figure 18).

- If this is OK, the problem is in V800 transistor or in R834, R830, C834, L800.

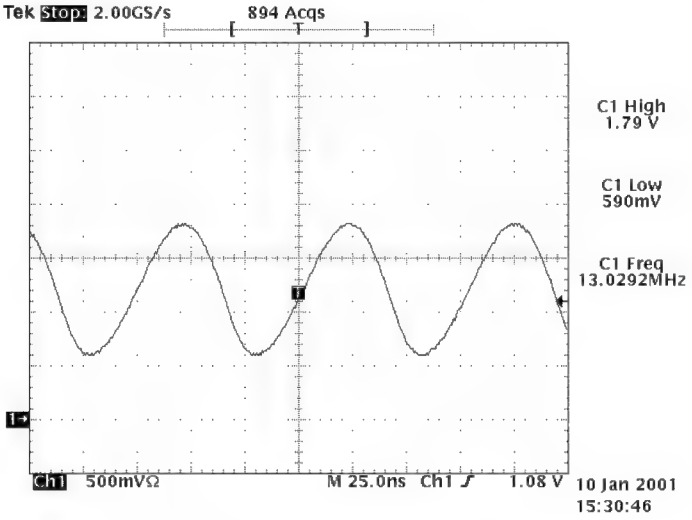


Figure 18. 13 MHz sine wave

2. Check VTCXO output at R833. This should be 26MHz sine wave (see Figure 19).

- If this is OK, Check R835, C830 for shorts and bad connections. If they are OK, Hagar (N505) or C800 or R829 is faulty.
- If this is not OK, R835, C830, R833 may be faulty. If they are OK, check VTCXO (G830).

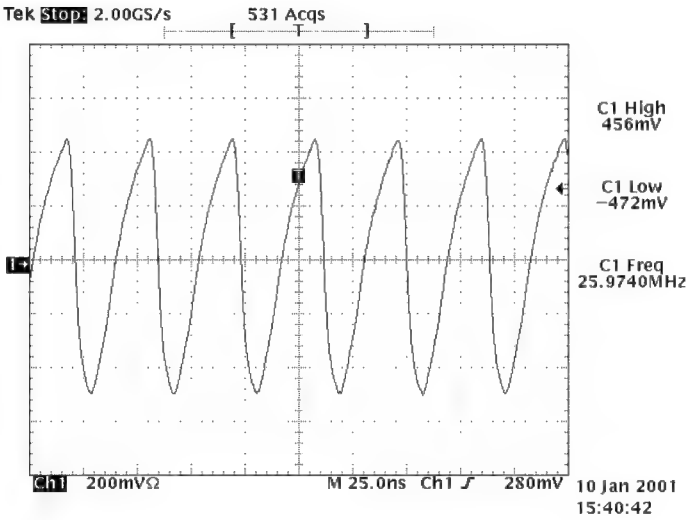


Figure 19. 26 MHz sine wave

2.8 Memory Tests

2.8.1 Test in boot up

FLASHes 0 (D351), 1 (D352) and 2 D(353):

– manufacturer and device id are read from each of the flashes then compared to value stored in FLASH 0.

– id read program code is executed from API RAM

– If FLASH 0 is broken the phone will not boot up properly (user test code resides in FLASH 0) i.e. probably not even blink CMT backlights.

– If one or more flash manufacturer and device id read fail CMT display backlights will blink 2 times in a loop.

SDRAM (D350):

– Data bus test:

- Test will detect if lines are stuck at high or low state
- Test will detect any bridging faults

– Address bus test:

- data is written to certain addresses and read back and verified

– tested lines: address bus, data bus, SDRRASX, SDRCASX, SDRWEX and SDRCLK

– SDRDQMU, SDRDQML and SDRCKE functionality is tested only partly

– If either of these tests fail CMT display backlights will blink 3 times in a loop

Serial FLASH (D354):

– Id is read and id bits (3–5) are compared to value 0x30

– If the test fails CMT display backlights will blink 4 times in a loop

– tested lines: SEPI, SEPO and SEPClk

SEPCSX (low) and EXT_SYS_RESETX (high) tested partly

– problems found with test SW:

- id read fails and CMT backlights blink but serial flash is ok ⇒ problem is in MADLinda

2.8.2 Test in PTS/WinTesla flashing

These tests are in the beginning of device flashing. If any of these tests fail the flashing will be stopped and a notification will be shown on the monitor screen.

SDRAM (D350):

– data is written to certain addresses, read back and compared

FLASHes 0 (D351), 1 (D352) and 2 D(353):

– device and manufacturer ids are read from each of the flashes and then the values are compared (same test as in boot up)

Serial FLASH (D354):

– device id is read and the value is compared (same test as in boot up)

2.9 Memory Troubleshooting

2.9.1 Memory fails In Boot Up tests, CMT Backlight is blinking

If the device won't boot up and CMT display backlight is blinking

⇒ FLASH 0 (D351) probably ok !

To measure signals from D352, D353, D350 and D354 the device needs to re-booted up constantly since the lines are active only a short time in the beginning of the boot.

Also CCONT WATCHDOG will shut the device off after 32 seconds !

Time between each memory device blinks is 1 second and time between different memory device blinks is 2 seconds.

For example if FLASH1 and Serial Flash are broken the blinking sequence goes:

2 blinks with 1 sec interval (FLASH fault)

2 sec without blinks

4 blinks with 1 sec intervals (Serial Flash fault)

2 sec without blinks

then to the beginning again

2.9.2 CMT display backlight blinking 2 times in a loop

CMT display backlight blinking 2 times in a loop (”Flash fault”):

Manufacturer and device id read from FLASH 1 (D352) or FLASH 2 (D353) or from both fails.

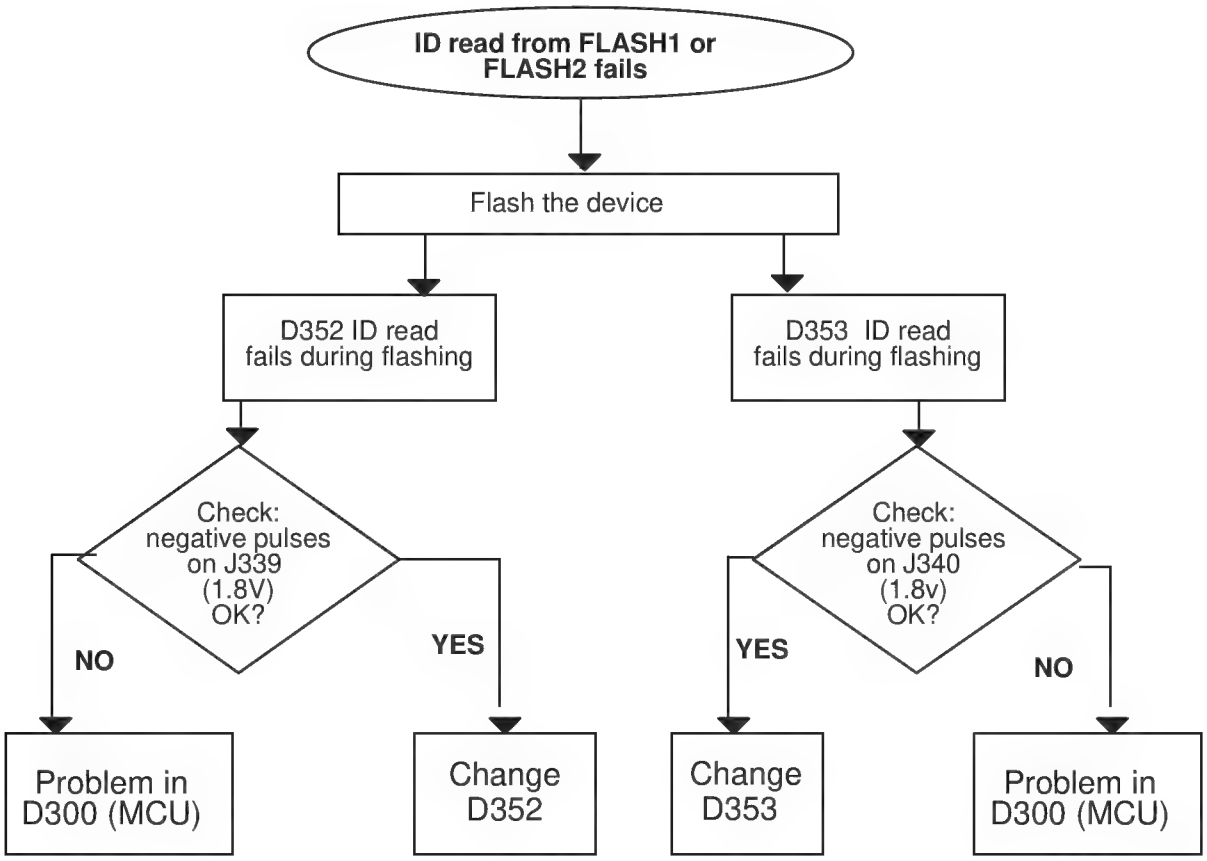


Figure 20.

See FLASH signal pictures later.

2.9.3 CMT display backlight blinking 3 times in a loop

CMT display backlight blinking 3 times in a loop ("SDRAM fault"):

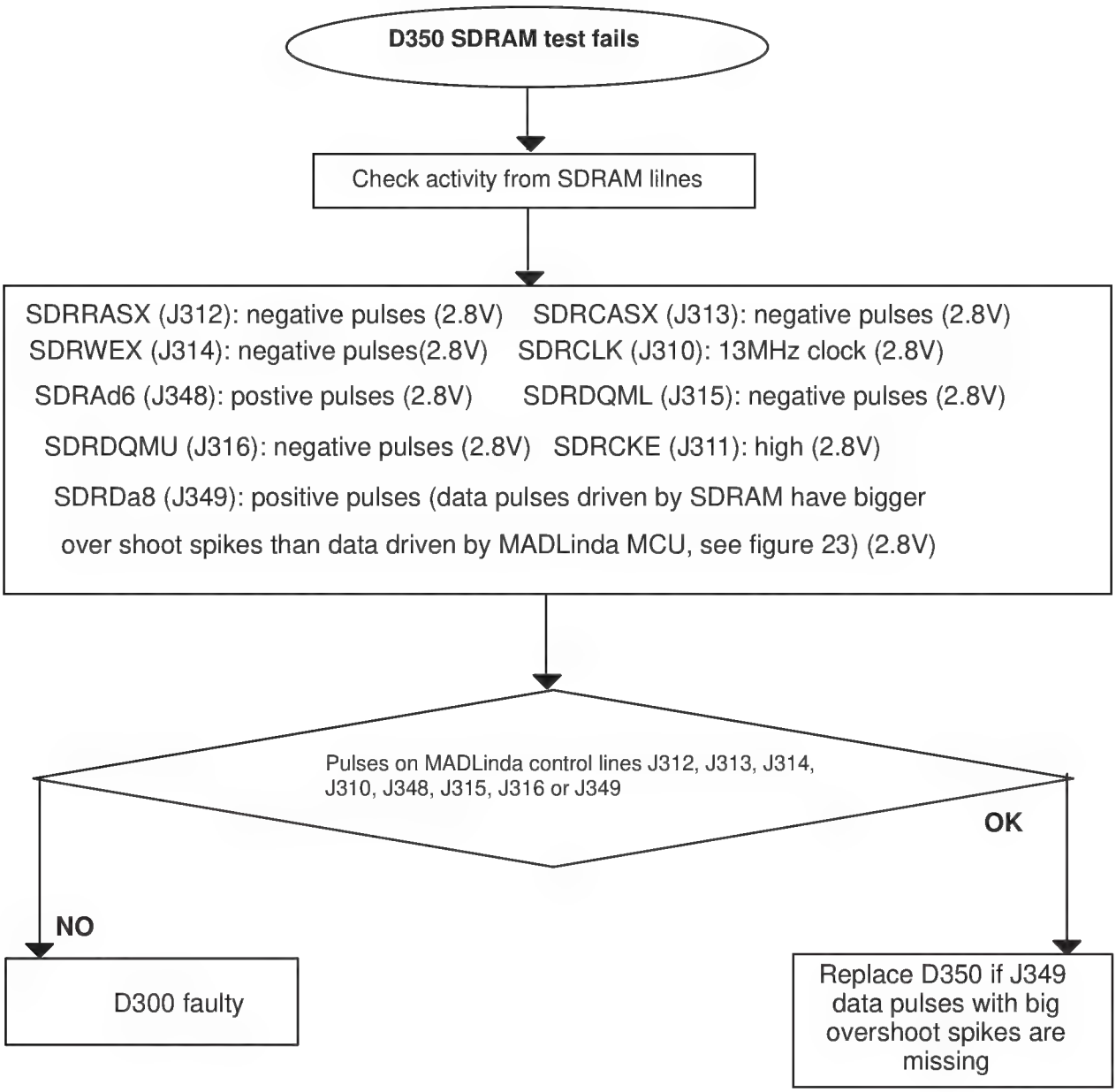

D350 SDRAM test fails
Check activity from SDRAM lilnes
SDRRASX (J312): negative pulses (2.8V) SDRCASX (J313): negative pulses (2.8V)
SDRWEX (J314): negative pulses(2.8V) SDRCLK (J310): 13MHz clock (2.8V)
SDRAd6 (J348): postive pulses (2.8V) SDRDQML (J315): negative pulses (2.8V)
SDRDQMU (J316): negative pulses (2.8V) SDRCKE (J311): high (2.8V)
SDRDa8 (J349): positive pulses (data pulses driven by SDRAM have bigger over shoot spikes than data driven by MADLinda MCU, see figure 23) (2.8V)
Pulses on MADLinda control lines J312, J313, J314, J310, J348, J315, J316 or J349
OK
NO
D300 faulty
Replace D350 if J349 data pulses with big overshoot spikes are missing

Figure 21.

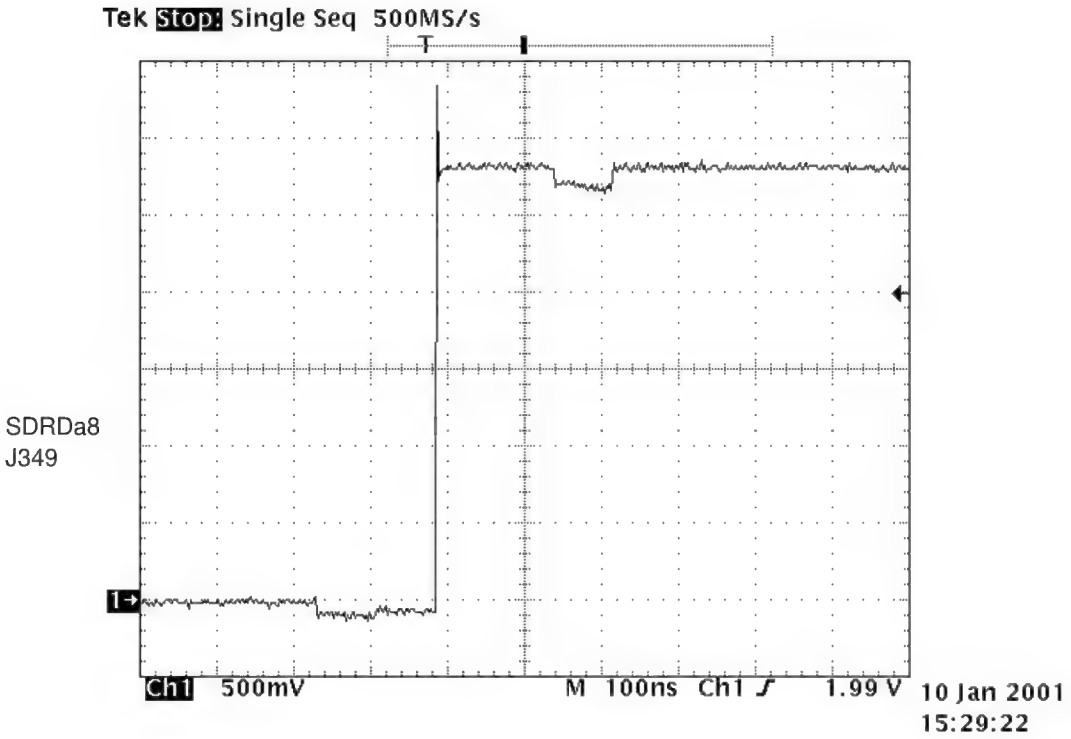


Figure 22. SDRAM (D350) driven data line SDRDa8 (J349)

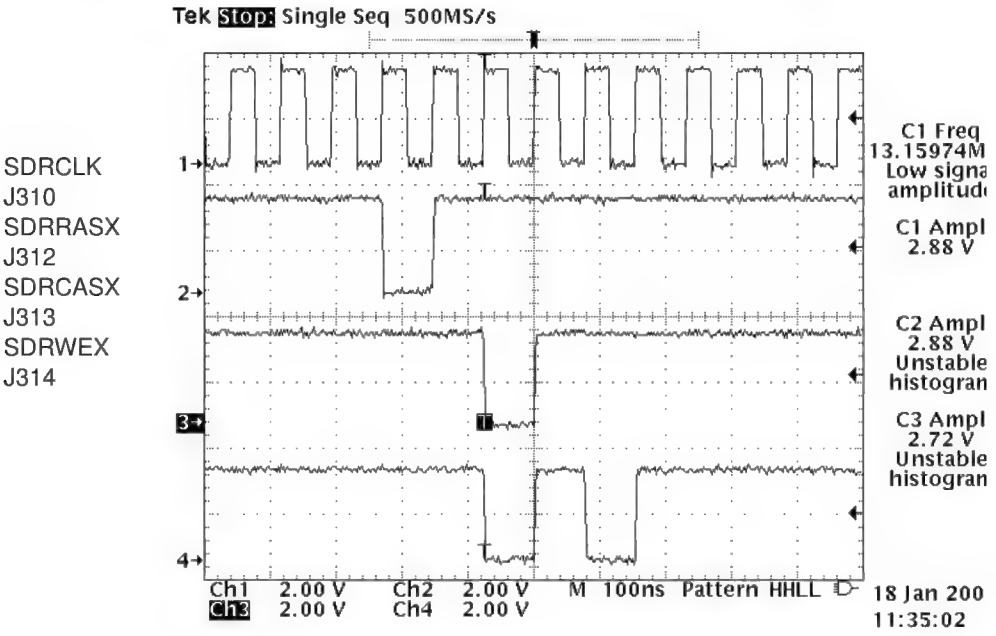


Figure 23. SDRAM signals and levels 1

SDRCLK
J310
SDRAd6
J348
SDRDQML
J315
SDRCKE
J311

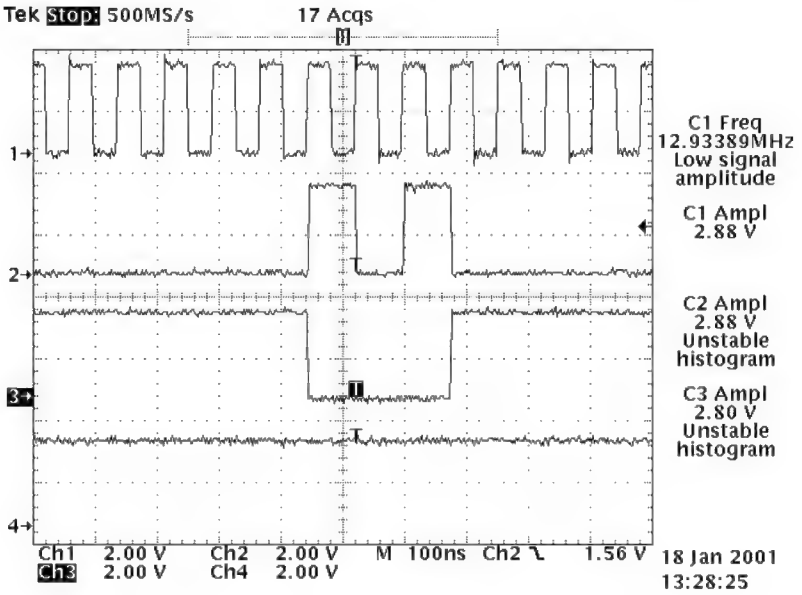


Figure 24. SDRAM signals and levels 2

2.9.4 CMT display backlight blinking 4 times in a loop

CMT display backlight blinking 4 times in a loop ("Serial Flash fault"):

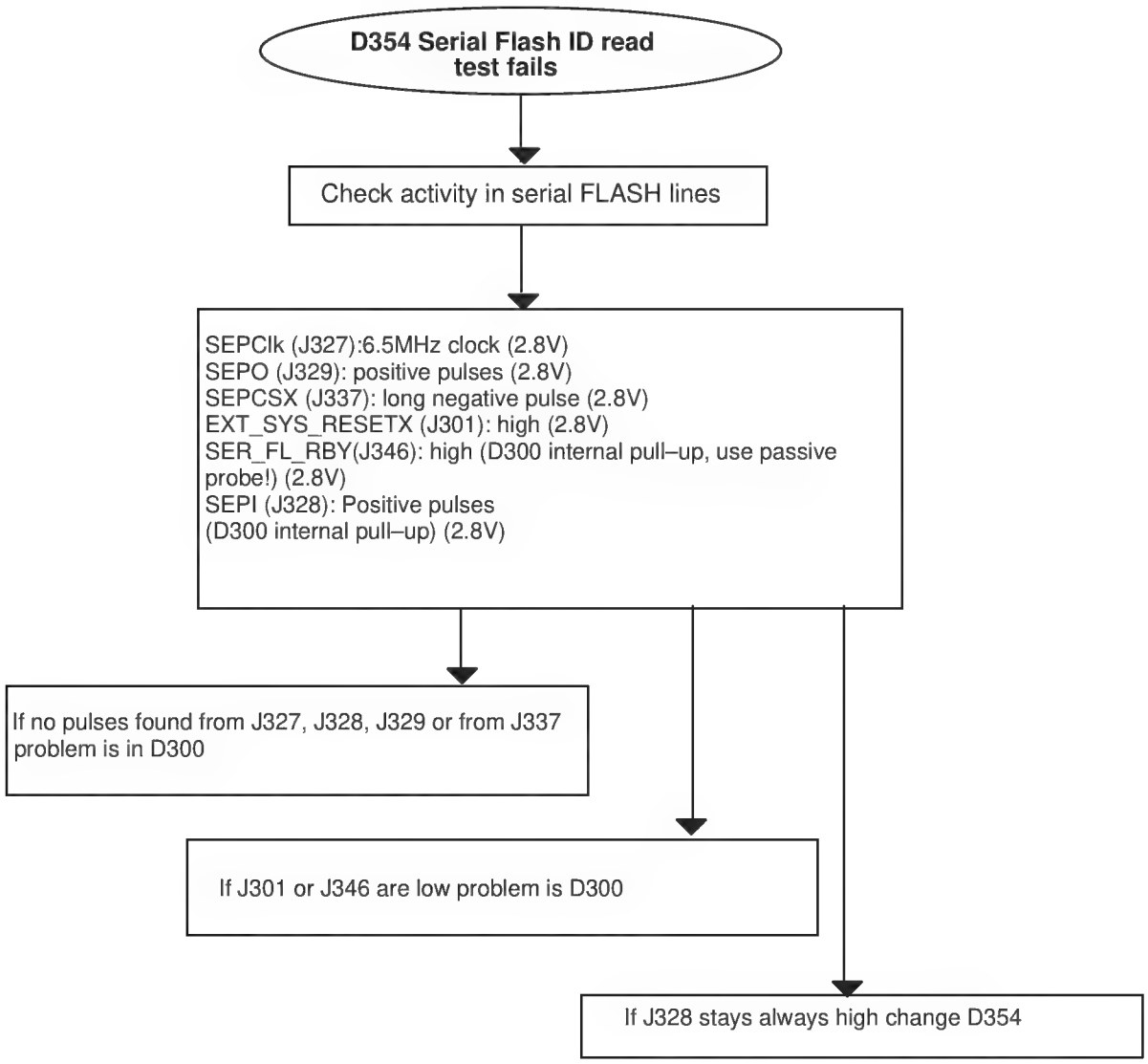

D354 Serial Flash ID read test fails
Check activity in serial FLASH lines
SEPClk (J327):6.5MHz clock (2.8V)
SEPO (J329): positive pulses (2.8V)
SEPCSX (J337): long negative pulse (2.8V)
EXT_SYS_RESETX (J301): high (2.8V)
SER_FL_RBY(J346): high (D300 internal pull–up, use passive probe!) (2.8V)
SEPI (J328): Positive pulses (D300 internal pull–up) (2.8V)
If no pulses found from J327, J328, J329 or from J337 problem is in D300
If J301 or J346 are low problem is D300
If J328 stays always high change D354

Figure 25.

SEPCLK
J327
SEPO
J329
SEPI
J328
SEPCSX
J337

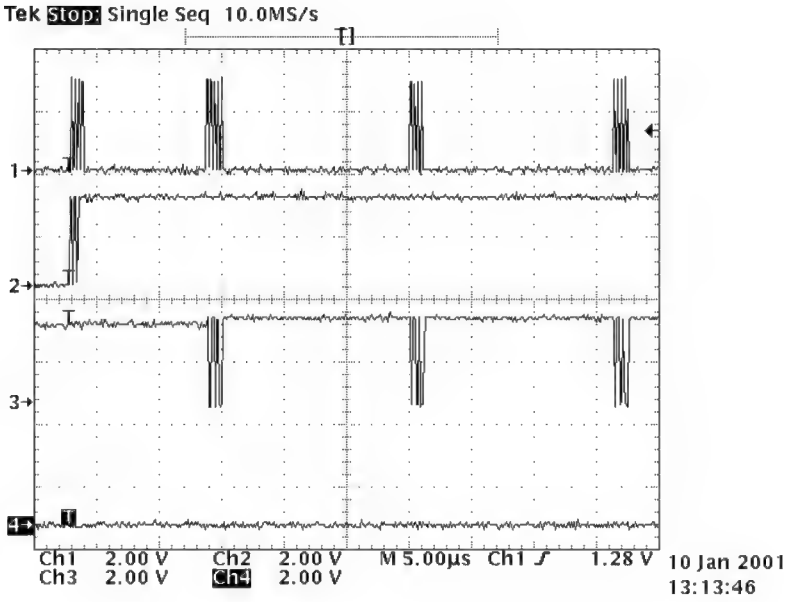


Figure 26. Serial Flash (D354) id read sequence.

2.9.5 Memory fails in PTS/WinTesla flashing

1. SDRAM id read test fails

   Refer to the previous "SDRAM fault" chapter.

2. Flash manufacturer and device id read fails

   a) If id read from all of the three flashes (D351, D352 and D353) fails most likely the problem is in D300.

   Check D300 and control lines:

   - FLDa7 (J351): positive pulses (1.8V)
   - FLCS0X (J338): negative pulses (1.8V)
   - FLOEX (J341): negative pulses (1.8V)
   - FLCS1X (J339): negative pulses (1.8V)
   - FLWEX (J342): negative pulses (1.8V)
   - FLCS2X (J340): negative pulses (1.8V)
   - FLAd5 (J350): positive pulses (1.8V)
   - FLRPX (J343): high (1.8V)
   - FLWPX (J347): low (1.8V)

   If any of the signals is missing the problem is in D300.

   b) If id read from one or two flashes fails

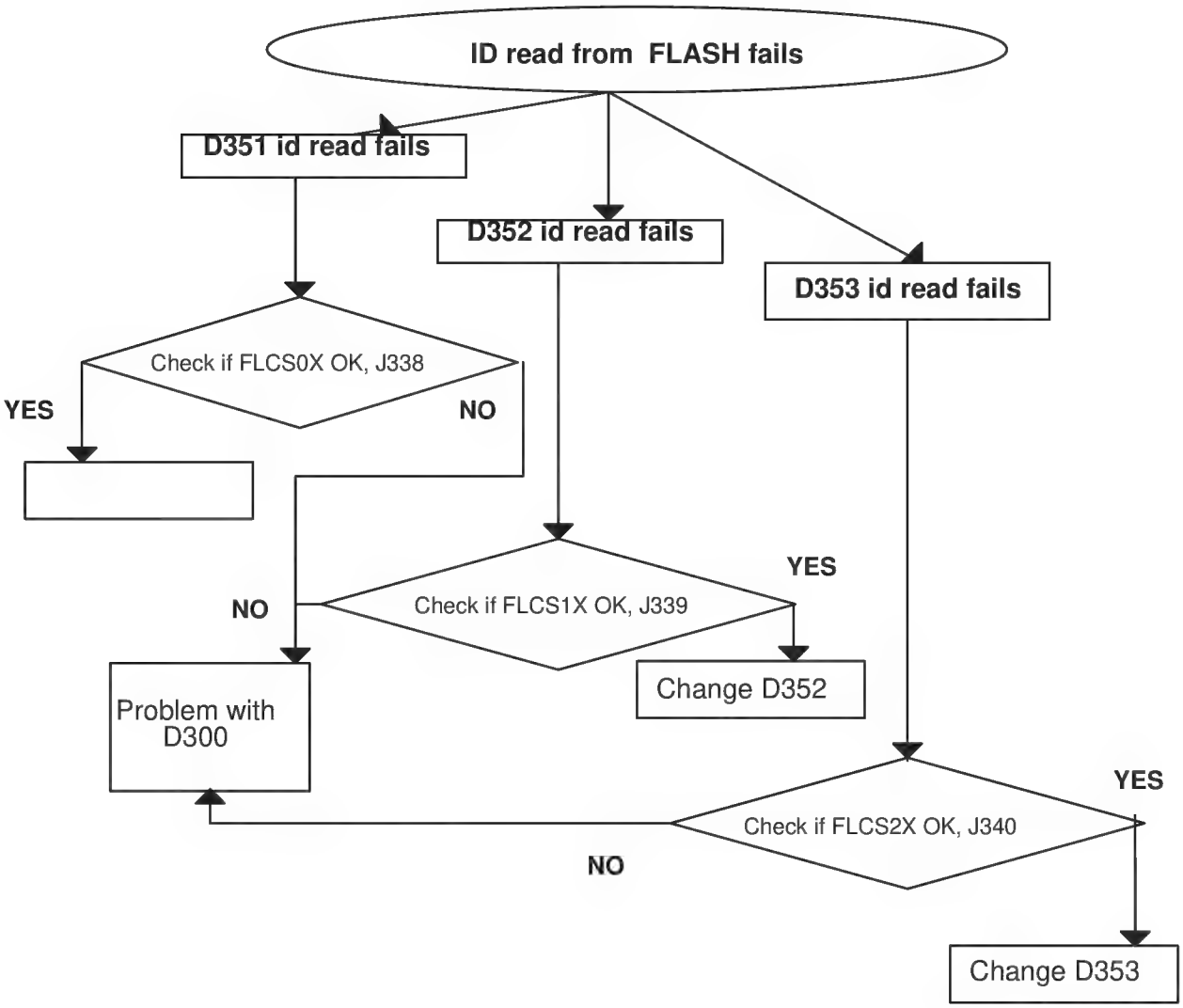


Figure 27.

Refer to the oscilloscope screen shots next page for what the signals should look like.

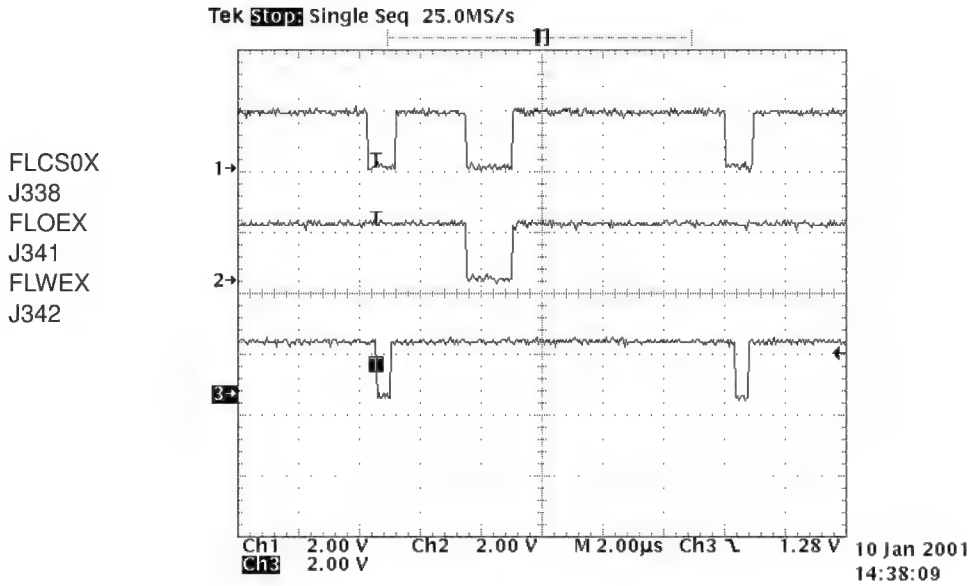


Figure 28. Flash 0 (D351) manufacturer and device id read

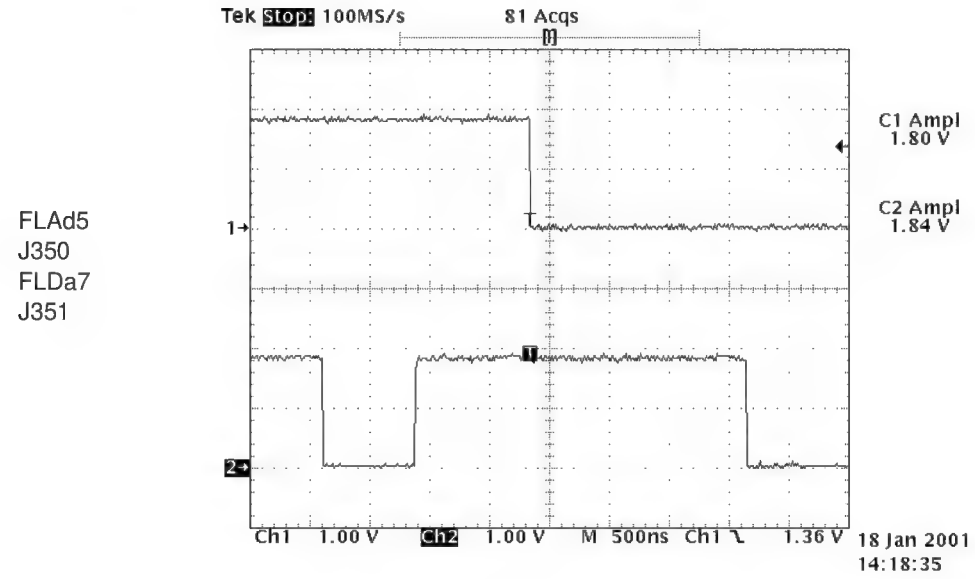


Figure 29. the Flash address and databus signals

2.9.6 Serial Flash id read test fails

Refer to previous chapter "Serial Flash fault" 2.1.2

2.10 Serial Interface Troubleshooting

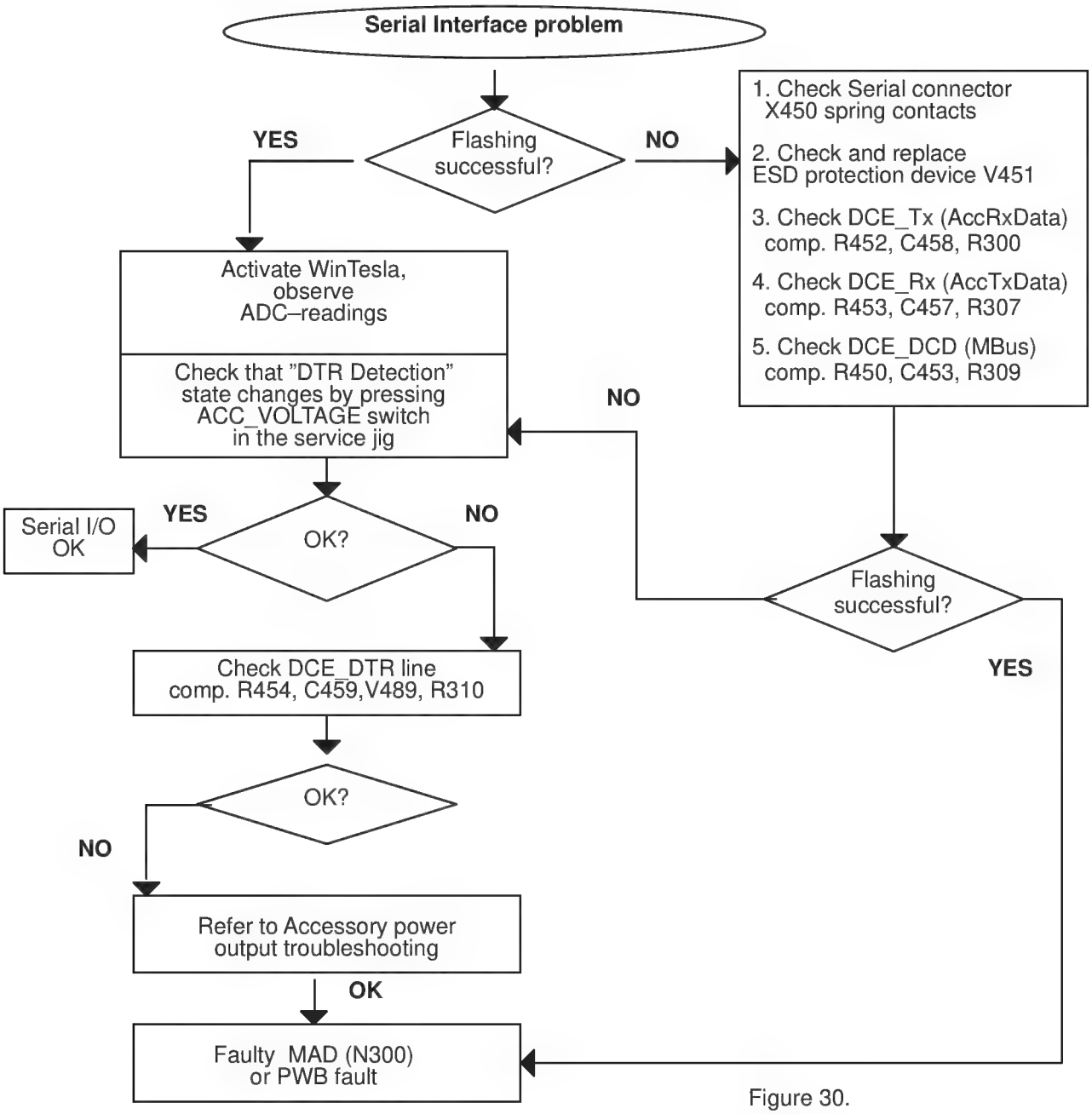

Serial Interface problem
Flashing successful?
YES
NO
1. Check Serial connector X450 spring contacts
2. Check and replace ESD protection device V451
3. Check DCE_Tx (AccRxData) comp. R452, C458, R300
4. Check DCE_Rx (AccTxData) comp. R453, C457, R307
5. Check DCE_DCD (MBus) comp. R450, C453, R309
Activate WinTesla, observe ADC–readings
Check that "DTR Detection" state changes by pressing ACC_VOLTAGE switch in the service jig
NO
Serial I/O OK
YES
OK?
NO
Flashing successful?
YES
Check DCE_DTR line comp. R454, C459,V489, R310
OK?
NO
Refer to Accessory power output troubleshooting
OK
Faulty MAD (N300) or PWB fault

Figure 30.

NOTE1: Ensure that the customer's DLR–2L is OK.

NOTE2: Wintesla ADC–readings for '**DTR Detection**': state "0" = DCE_DTR – line at 2.8 – 3.0V

Wintesla ADC–readings for '**DTR Detection**': state "1" = DCE_DTR – line at 0 – 0.3V

NOTE3: Signal levels in practice: High $\geq$ 2.7V, Low $\leq$ 0.3V

Exception: Diode in DTR line causes voltage drop, see Figure 31 below:

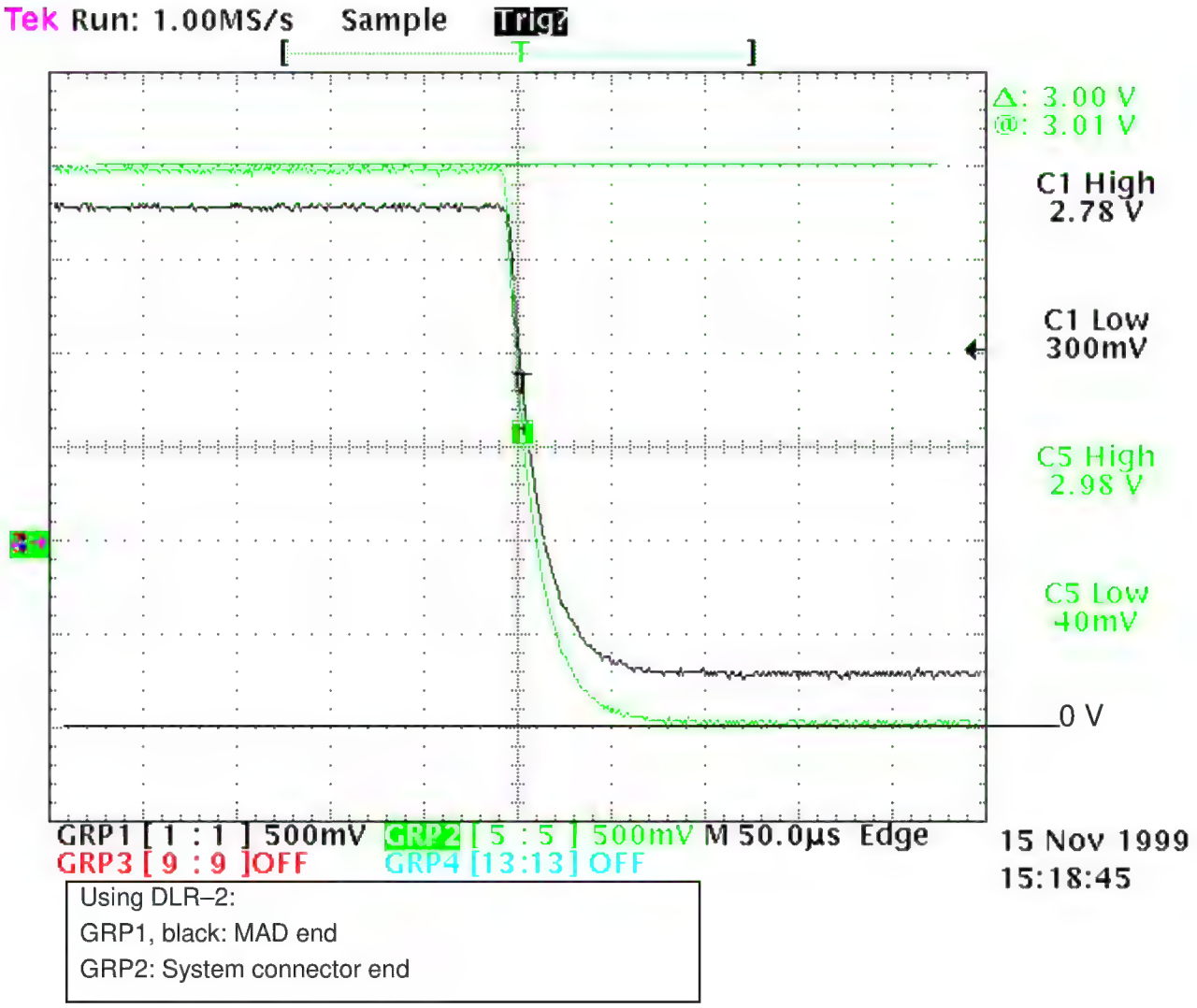
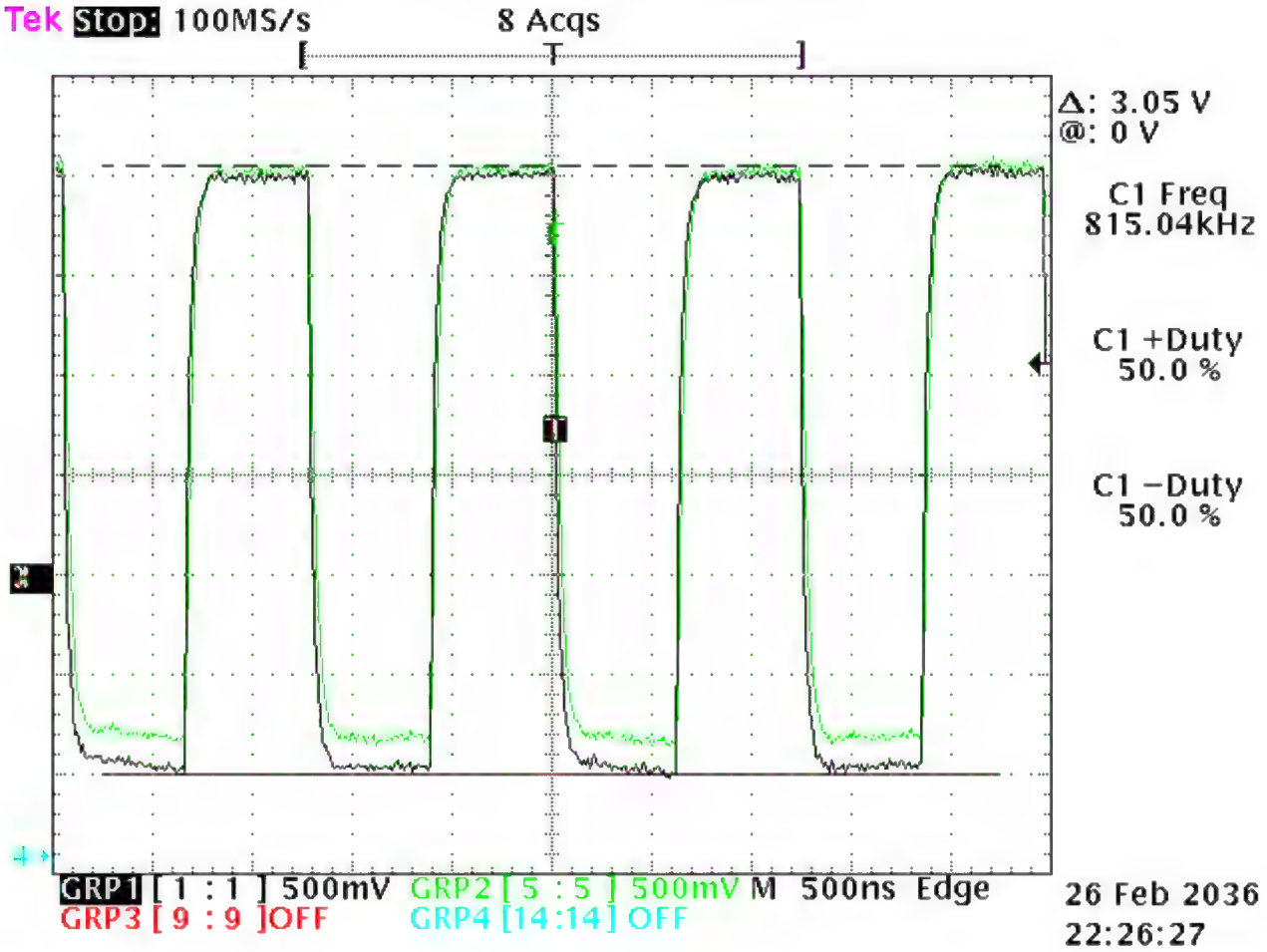


Figure 31. DTH line voltage

MBUS (clock) Signal during flashing (Figure 32):



GRP1, black: MAD–end
GRP2: system connector end
Approx. 0.2V difference results from MBUS pull–up resistor (R309, 4k7) & serial resistor (R450, 270R) voltage slicing.

Figure 32. MBUS (clock) Signal during flashing

2.11 CONTACT SERVICE in CMT display

CONTACT SERVICE in CMT display (Self-tests with WinTesla)

Display Information: "**Contact Service**"

This fault means that software is able to run and thus the watchdog of CCONT (N100) can be served. Self–test functions are executed when power is switched on and software is started to execute from flash.

If any one of the self–tests fails (except no. 3, 7, 8, and F), the text "Contact Service" is shown in the phone display.

MCU Self–tests are divided into those executed while power up (tests: 1–5 and 9–I) and the ones can be executed with the connected PC. The tests and included items are as follows (Figure 33, screendump from the WinTesla)

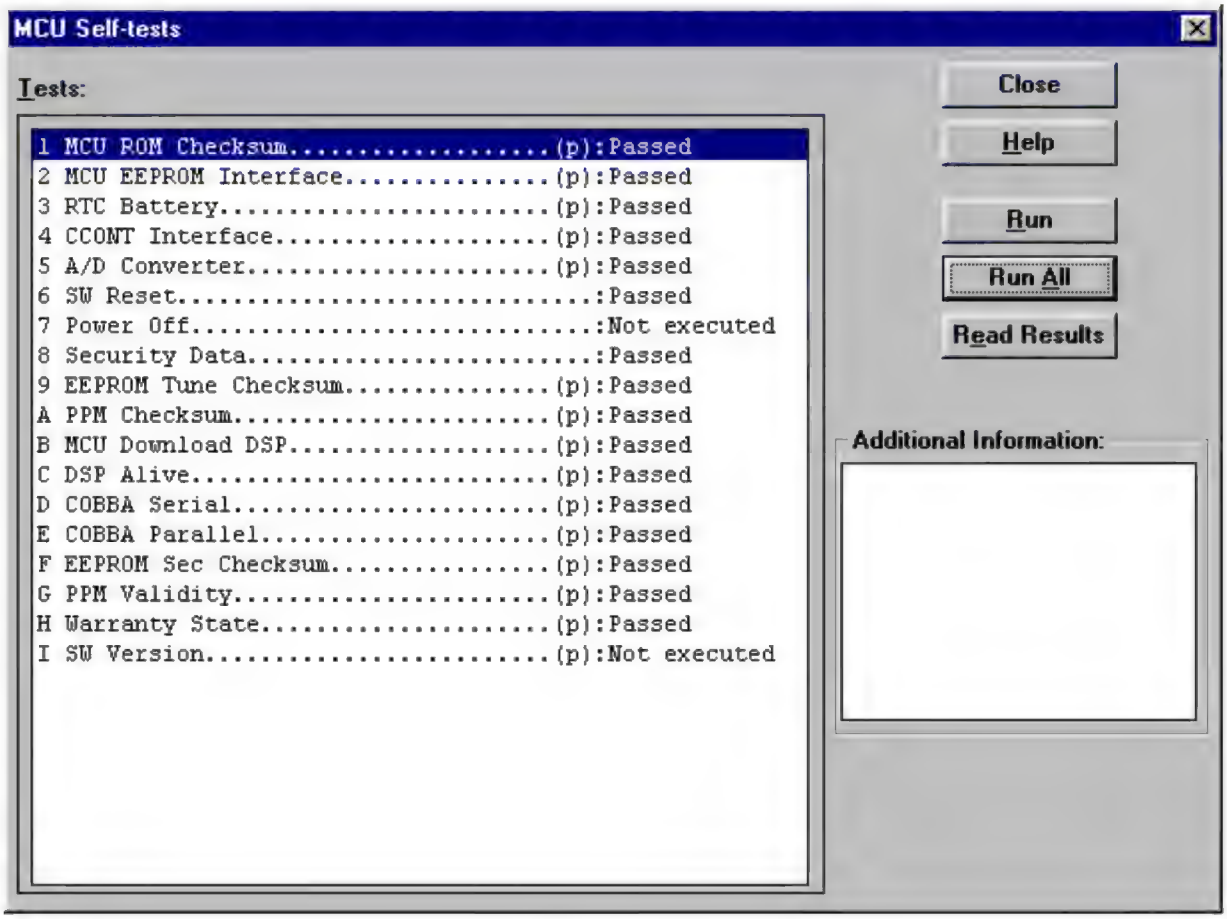


Figure 33.

The information can be used for diagnosis.

Memory tests differ from normal DCT3 self–tests. They can not be executed in the ENOS because memory protection.

There is no EEPROM. The EEPROM is emulated in the FLASH (part of CS2). All contents where EEPROM is mentioned refer to emulated EEPROM.

Item no. 1; MCU ROM Checksum:

Calculates 16 bit checksum out of Flash code and compares it to the one found in Flash. Items being checked are MADLinda <–> Flash data– and address lines FLDa0–15 and FLAd1–21, FLCS0X (CE0), FLCS1X (CE1), FLCS2X (CE2), FLWEX (WE), Vbb (Vcc), VCORE (Vccq), GND, and Flash internal functionality.

Item no. 2 MCU EEPROM Interface:

Checks current PMM error status. If this test FAILs, the PMM data is not valid anymore and should be formatted.

Item no. D COBBA Serial

This test tests Audio interface (PCM) of the COBBA_GJP.

Item no. E COBBA Parallel

This test tests the serial control/RF interface of the COBBA_GJP.

2.12 CCONT Serial interface Troubleshooting

If there are problems in CCONT's serial control interface, self tests fail and there is "Contact service" shown on the display. Wintesla shows this fail as "CCONT Interface".

NOTE: Low level means 0V, high level means approximately 2.8V.

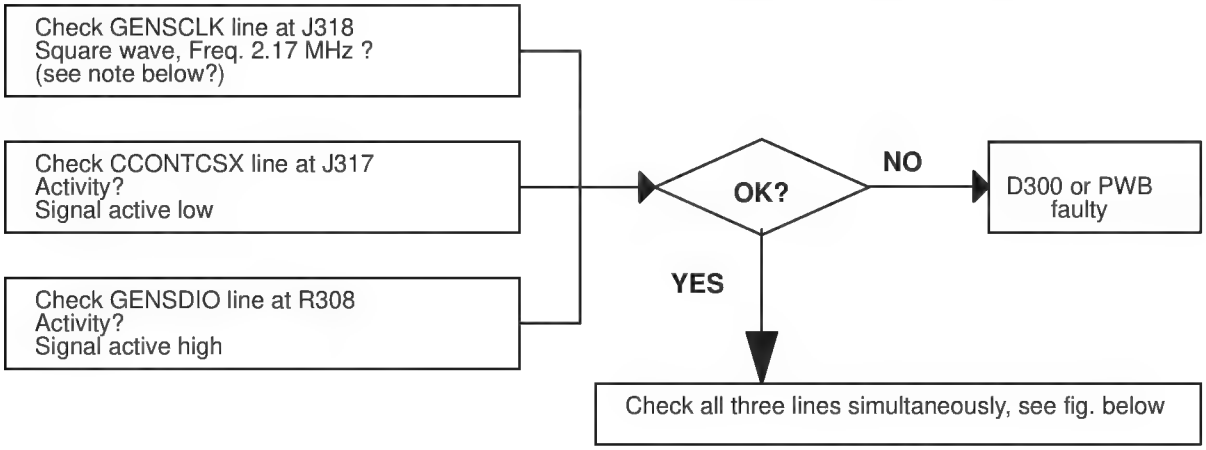


Figure 34.

(Note: Measurement should show 2.17MHz square wave. This interface is connected to CMT display also, so there is other activity too. The 3.1MHz clock is targeted for CMT display, do not worry about that. The clock signal is low when inactive.)

1. Measure all the three lines simultaneously (Figure 35).

   Set the trigger to CCONTCSX line falling edge.

   You should see the two cases, Figure 35 and Figure 36 .
   (Channel 1–GENSClk,
   Channel 2–CCONTCSX,
   Channel 3–GENSDIO). High level is about 2.8V

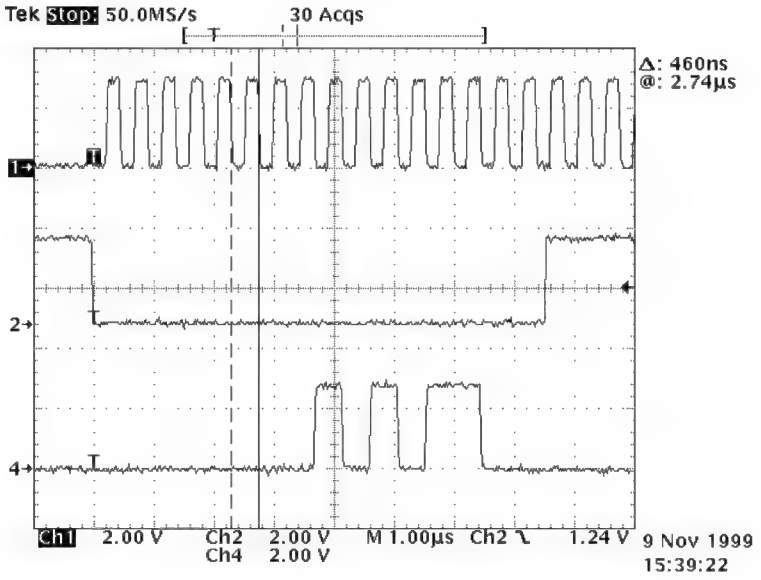


Figure 35.

MADLinda writes to CCONT. The data at sixth bit is '0' as marked with the cursors. The data after the read/write bit varies, just like the address before the bit. If you can see this kind of traffic, MADLinda side of the interface is functioning correctly.

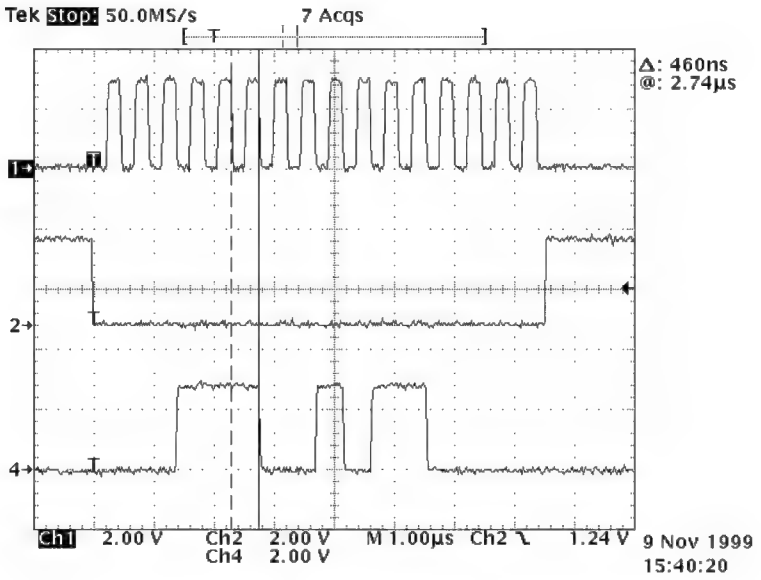


Figure 36.

MADLinda reads from CCONT. The data at sixth bit is '1', marked with the cursors. There should be data seen after the 'read' bit. All zero values may be read, but there should be other data seen, too. CCONT read cycles are fairly rare compared to write cycles. If there is not any non–zero reads from CCONT, the CCONT (N100) may be faulty.

2.13 SIM Card

2.13.1 SIM Card Error Troubleshooting

The fault information "SIM Card error" means most likely that the SIM locked phone has been inserted with a SIM which does not correspond to the lock code.

Check the SIM lock status of the phone with WinTesla:

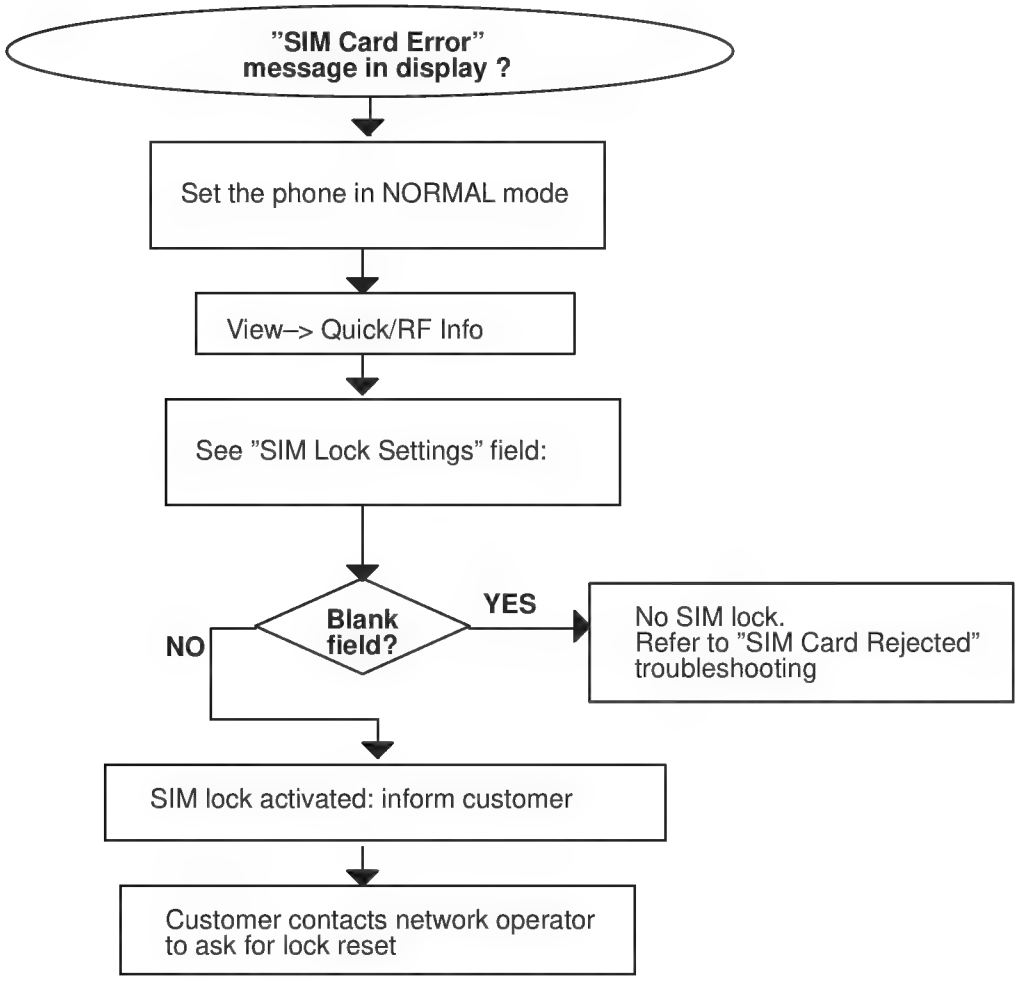

"SIM Card Error" message in display ?
Set the phone in NORMAL mode
View–> Quick/RF Info
See "SIM Lock Settings" field:
Blank field?
YES
NO
No SIM lock. Refer to "SIM Card Rejected" troubleshooting
SIM lock activated: inform customer
Customer contacts network operator to ask for lock reset

Figure 37.

2.13.2 SIM Card Rejected

The fault information "SIM Card rejected" means that the ATR message (Answer To Reset; the first message from SIM card to phone after SIM card power up) is sent, but it is corrupted somehow, eg. the dataline signal levels are wrong or factory set values (stored in the EEPROM) are not correct.

NOTE1: CHECK THE MEASUREMENT POINT PICTURE BEFORE SERVICE ACTIONS

SIM_xxx_Cardside – refers to signal which exists in SIM card contacts

SIM_xxx_o – refers to signal which exists in CCONT(N100) side

NOTE2: SIM Signals between CCONT (N100) and LindaMAD (D300) are not possible to measure in bl8–module because traces are running in inner layers of PWB.

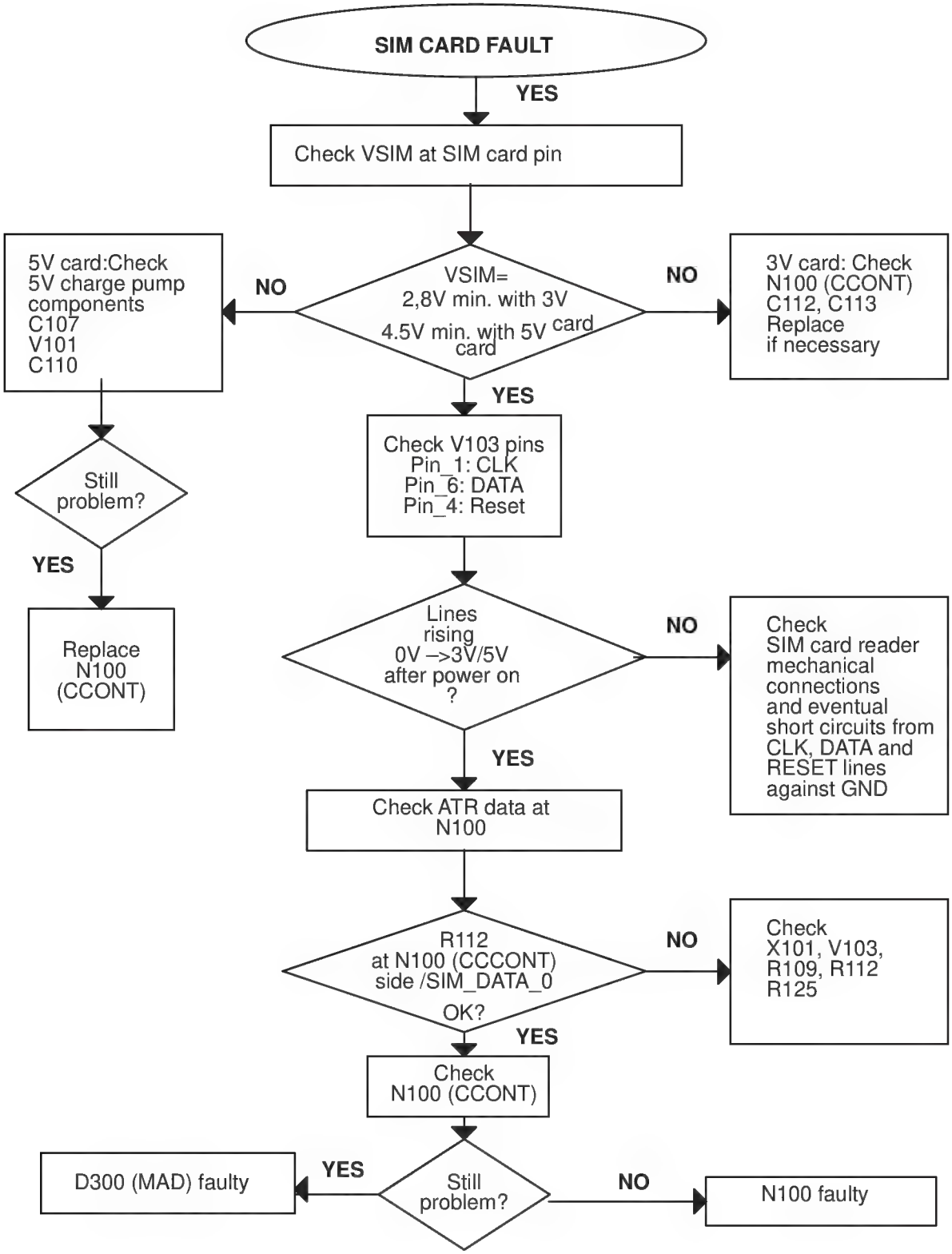

SIM CARD FAULT
YES
Check VSIM at SIM card pin
VSIM=
2,8V min. with 3V
4.5V min. with 5V card
card
NO
NO
5V card:Check
5V charge pump
components
C107
V101
C110
3V card: Check
N100 (CCONT)
C112, C113
Replace
if necessary
YES
Still
problem?
YES
Replace
N100
(CCONT)
Check V103 pins
Pin_1: CLK
Pin_6: DATA
Pin_4: Reset
Lines
rising
0V –>3V/5V
after power on
?
NO
Check
SIM card reader
mechanical
connections
and eventual
short circuits from
CLK, DATA and
RESET lines
against GND
YES
Check ATR data at
N100
R112
at N100 (CCCONT)
side /SIM_DATA_0
OK?
NO
Check
X101, V103,
R109, R112
R125
YES
Check
N100 (CCONT)
D300 (MAD) faulty
YES
Still
problem?
NO
N100 faulty

Figure 38.

2.13.3 Insert SIM card

The hardware of the SIM interface from the MADLinda (D300) to the SIM connector (X101) can be tested without SIM card. This leaves SIM connector (X101) contacts to be used as an measurement points.

When the power is switched on and if the BSI line (X100:2) is grounded by resistor (which happens automatically in service jig), all the used lines (VSIM, RST, CLK & DATA) rise up to 3V and/or 5V four times (SW tries to ask SIM card four times).

NOTE1: CHECK THE MEASUREMENT POINT PICTURE BEFORE SERVICE ACTIONS

SIM_xxx_Cardside – refers to signal which exists in SIM card contacts

SIM_xxx_o – refers to signal which exists in CCONT(N100) side

NOTE2: SIM Signals between CCONT (N100) and LindaMAD (D300) are not possible to measure in BL8–module because traces are running in inner layers of PWB.

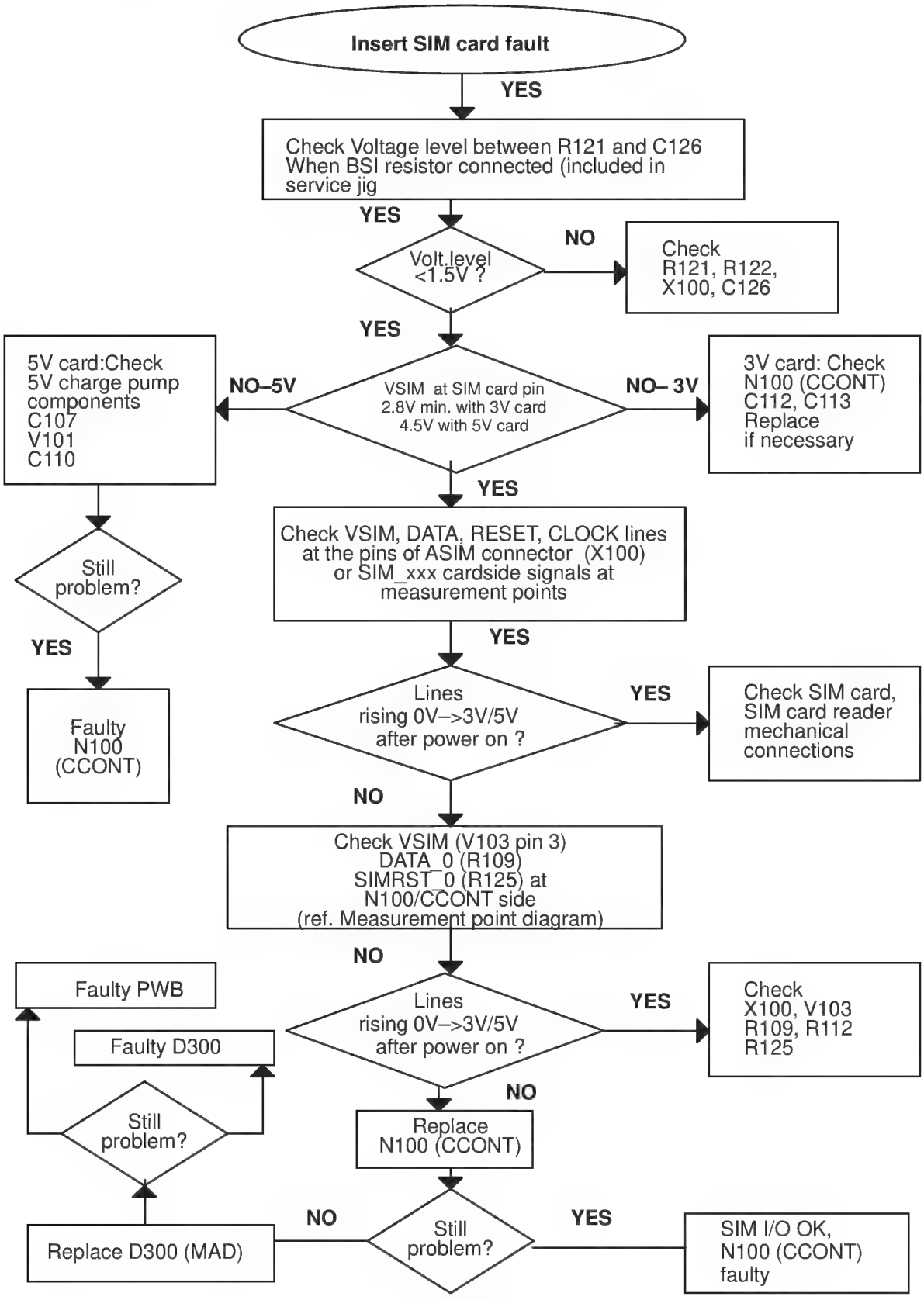

Insert SIM card fault
YES
Check Voltage level between R121 and C126
When BSI resistor connected (included in
service jig
YES
Volt.level
<1.5V ?
NO
Check
R121, R122,
X100, C126
YES
5V card:Check
5V charge pump
components
C107
V101
C110
NO–5V
VSIM at SIM card pin
2.8V min. with 3V card
4.5V with 5V card
NO– 3V
3V card: Check
N100 (CCONT)
C112, C113
Replace
if necessary
YES
Still
problem?
YES
Check VSIM, DATA, RESET, CLOCK lines
at the pins of ASIM connector (X100)
or SIM_xxx cardside signals at
measurement points
YES
Faulty
N100
(CCONT)
Lines
rising 0V–>3V/5V
after power on ?
YES
Check SIM card,
SIM card reader
mechanical
connections
NO
Check VSIM (V103 pin 3)
DATA_0 (R109)
SIMRST_0 (R125) at
N100/CCONT side
(ref. Measurement point diagram)
NO
Faulty PWB
Lines
rising 0V–>3V/5V
after power on ?
YES
Check
X100, V103
R109, R112
R125
Faulty D300
NO
Still
problem?
Replace
N100 (CCONT)
NO
Still
problem?
YES
Replace D300 (MAD)
SIM I/O OK,
N100 (CCONT)
faulty

Figure 39.

2.14 Memory Card

2.14.1 Memory Card Interface Troubleshooting

Start with assembled device with a faultless memory card inserted.

If necessary, proceed with tests in the jig with the faultless memory card inserted.

Clk, Cmd and Data OK means that frequency, rise and fall timing are OK during various operating modes.

Note:
During initialization phase (MMCClk = lower frequency) the response via MMCCmd line from card to MAD is sent in open drain mode i.e. rise time is about 1us.
Voltage of MMCCmd and MMCDa signals depends on direction of transfer (MAD I/O voltage is 2.8V and Card I/O is 3.0V).

Test pads J10x are located on the JL4 board of the Module Jig.

Troubleshooting diagram next page, Figure 40.

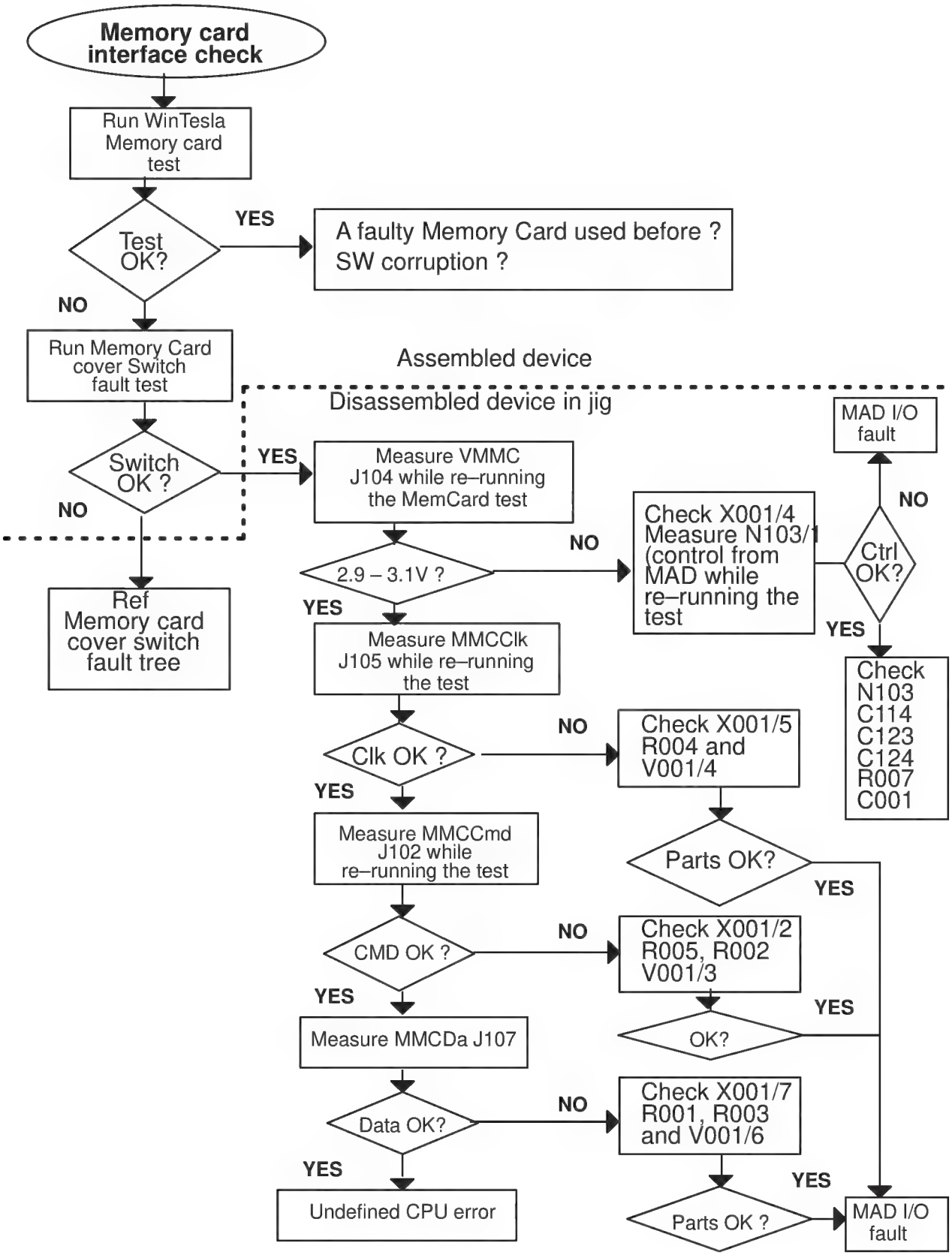

Memory card interface check
Run WinTesla Memory card test
Test OK?
YES
A faulty Memory Card used before ? SW corruption ?
NO
Run Memory Card cover Switch fault test
Assembled device
Disassembled device in jig
Switch OK ?
YES
NO
Measure VMMC J104 while re–running the MemCard test
Ref Memory card cover switch fault tree
2.9 – 3.1V ?
NO
YES
Check X001/4 Measure N103/1 (control from MAD while re–running the test
Ctrl OK?
NO
YES
MAD I/O fault
Check N103 C114 C123 C124 R007 C001
Measure MMCClk J105 while re–running the test
Clk OK ?
NO
YES
Check X001/5 R004 and V001/4
Measure MMCCmd J102 while re–running the test
Parts OK?
YES
CMD OK ?
NO
YES
Check X001/2 R005, R002 V001/3
OK?
YES
Measure MMCDa J107
Data OK?
NO
YES
Check X001/7 R001, R003 and V001/6
Undefined CPU error
Parts OK ?
YES
MAD I/O fault

Figure 40.

2.14.2 Memory card switch troubleshooting:

NOTE1: Memory card switch pressed (lid closed) => ADC reading 'Memory Card Cover Detection' is in state "0" => MMC_Switch – line = 0V

Memory card switch released (lid opened) => ADC reading 'Memory Card Cover Detection' is in state "1" => MMC_Switch – line = 2.8V

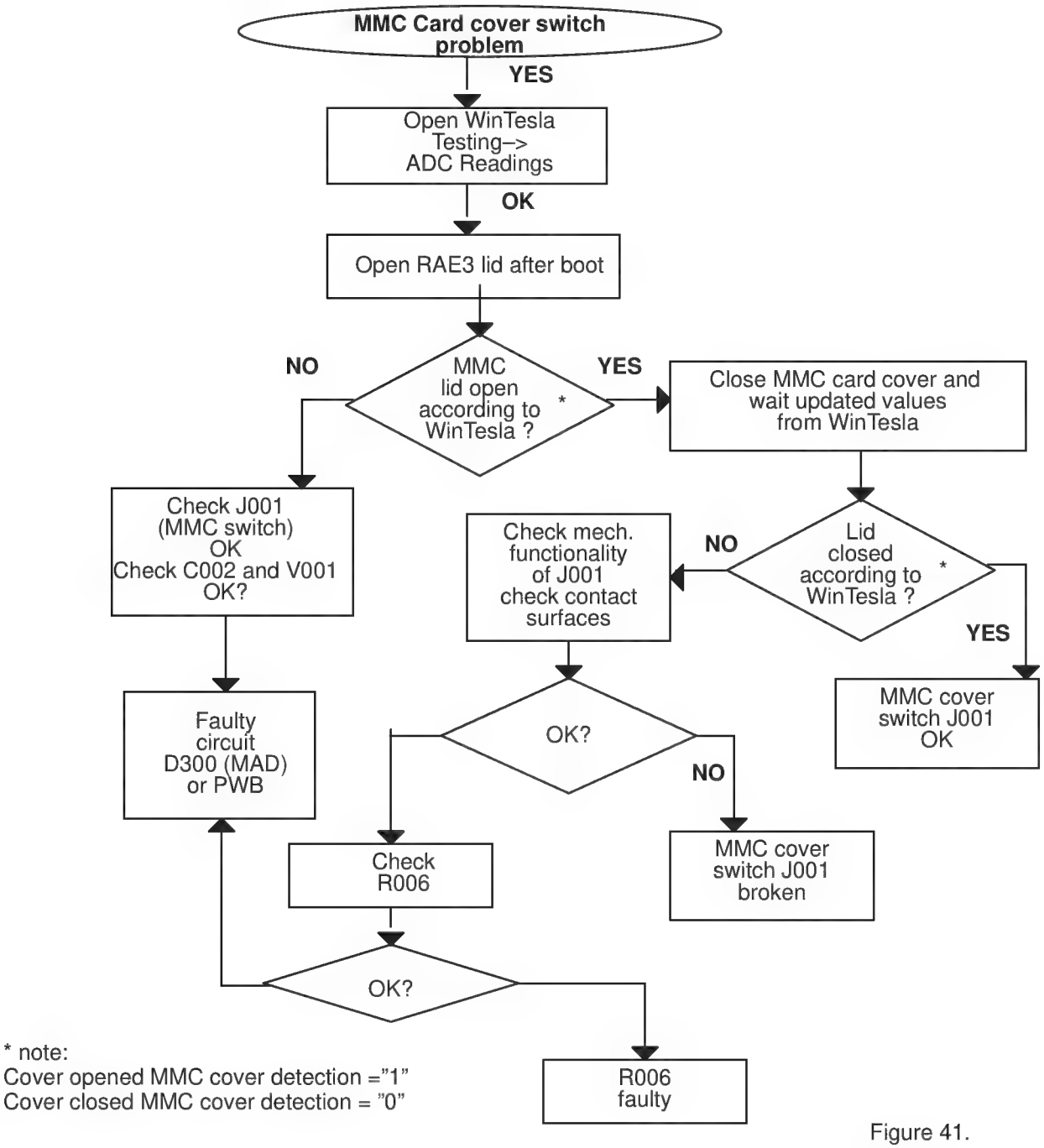

MMC Card cover switch problem
YES
Open WinTesla Testing–> ADC Readings
OK
Open RAE3 lid after boot
NO
MMC lid open according to WinTesla ? *
YES
Close MMC card cover and wait updated values from WinTesla
Check J001 (MMC switch) OK Check C002 and V001 OK?
Check mech. functionality of J001 check contact surfaces
NO
Lid closed according to WinTesla ? *
YES
MMC cover switch J001 OK
Faulty circuit D300 (MAD) or PWB
OK?
NO
Check R006
MMC cover switch J001 broken
OK?
R006 faulty
* note:
Cover opened MMC cover detection ="1"
Cover closed MMC cover detection = "0"

Figure 41.

2.15 Lid Switch

2.15.1 Lid Switch Troubleshooting

NOTE1:

Lid signal (MAD pin P2 gendet) :

Lid closed = **'Cover Detection'** from Wintesla ADC readings is **state "0"**

=> V301 (HALL) output = **2.8**V

Lid opened = **'Cover Detection'** from Wintesla ADC readings is **state "1"**

=> V301 (HALL) output = **0**V

Troubleshooting diagram Figure 42 next page.

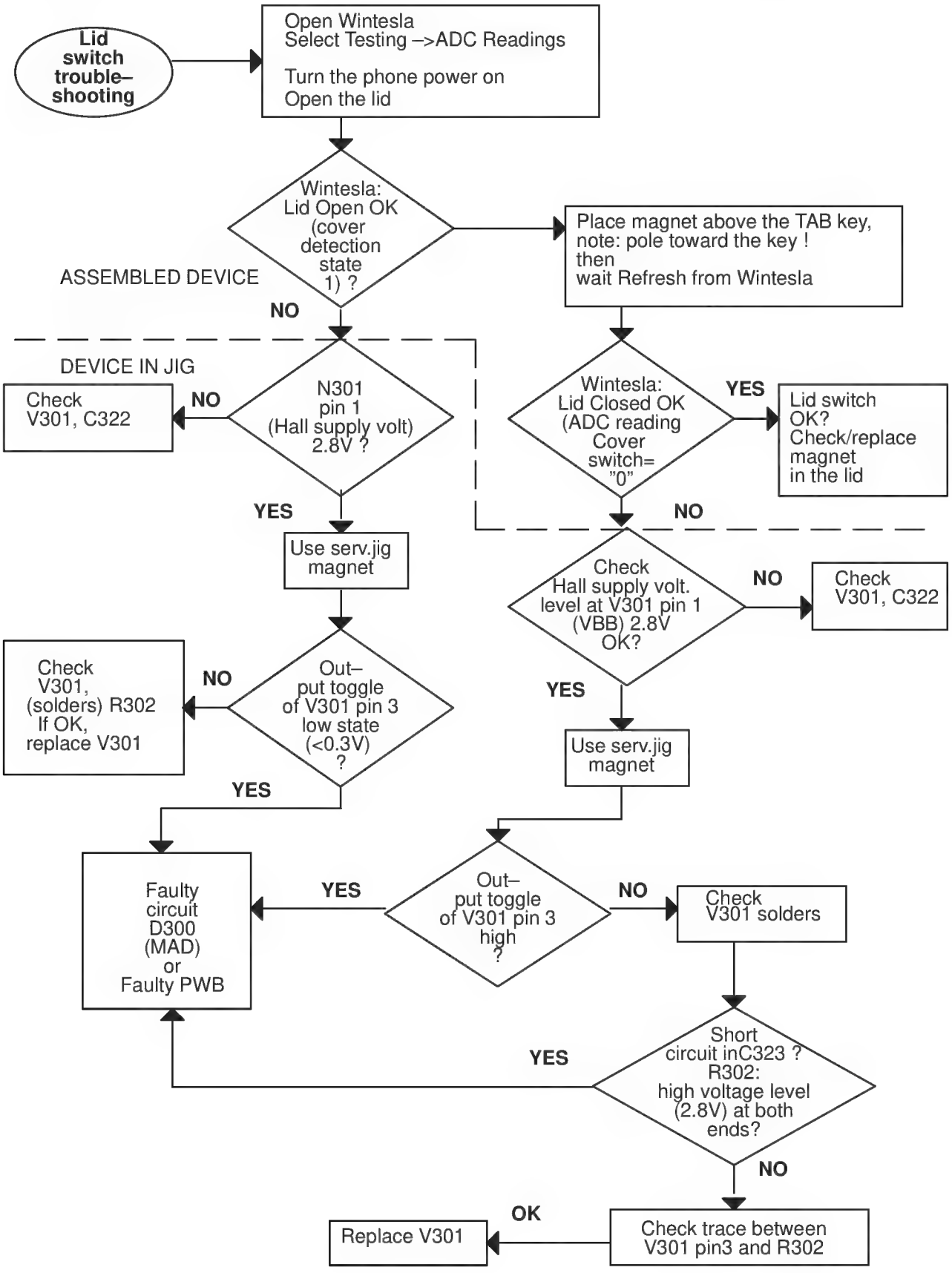

Lid switch trouble– shooting
Open Wintesla
Select Testing –>ADC Readings
Turn the phone power on
Open the lid
Wintesla: Lid Open OK (cover detection state 1) ?
ASSEMBLED DEVICE
NO
Place magnet above the TAB key, note: pole toward the key ! then wait Refresh from Wintesla
DEVICE IN JIG
Check V301, C322
NO
N301 pin 1 (Hall supply volt) 2.8V ?
Wintesla: Lid Closed OK (ADC reading Cover switch= "0"
YES
Lid switch OK? Check/replace magnet in the lid
YES
NO
Use serv.jig magnet
Check Hall supply volt. level at V301 pin 1 (VBB) 2.8V OK?
NO
Check V301, C322
Check V301, (solders) R302 If OK, replace V301
NO
Out– put toggle of V301 pin 3 low state (<0.3V) ?
YES
Use serv.jig magnet
YES
Faulty circuit D300 (MAD) or Faulty PWB
YES
Out– put toggle of V301 pin 3 high ?
NO
Check V301 solders
YES
Short circuit inC323 ? R302: high voltage level (2.8V) at both ends?
NO
OK
Replace V301
Check trace between V301 pin3 and R302

Figure 42.

2.16 Battery Removal Switch troubleshooting

NOTE1: Switch itself is not possible to test in service jig.

NOTE2: Switch FREE position = Wintesla ADC–readings **'Battery Removal Switch'** is in state "0" =>BATT_REM – line = 2.8V

Switch CONNECTED position = Wintesla ADC–readings **'Battery Removal Switch'** is in state "1" => BATT_REM – line = 0V

NOTE3: Battery removal **switch** (latch spring) gets connected when battery **latch** is pressed during battery release.

Refer to the diagram Figure 43 next page.

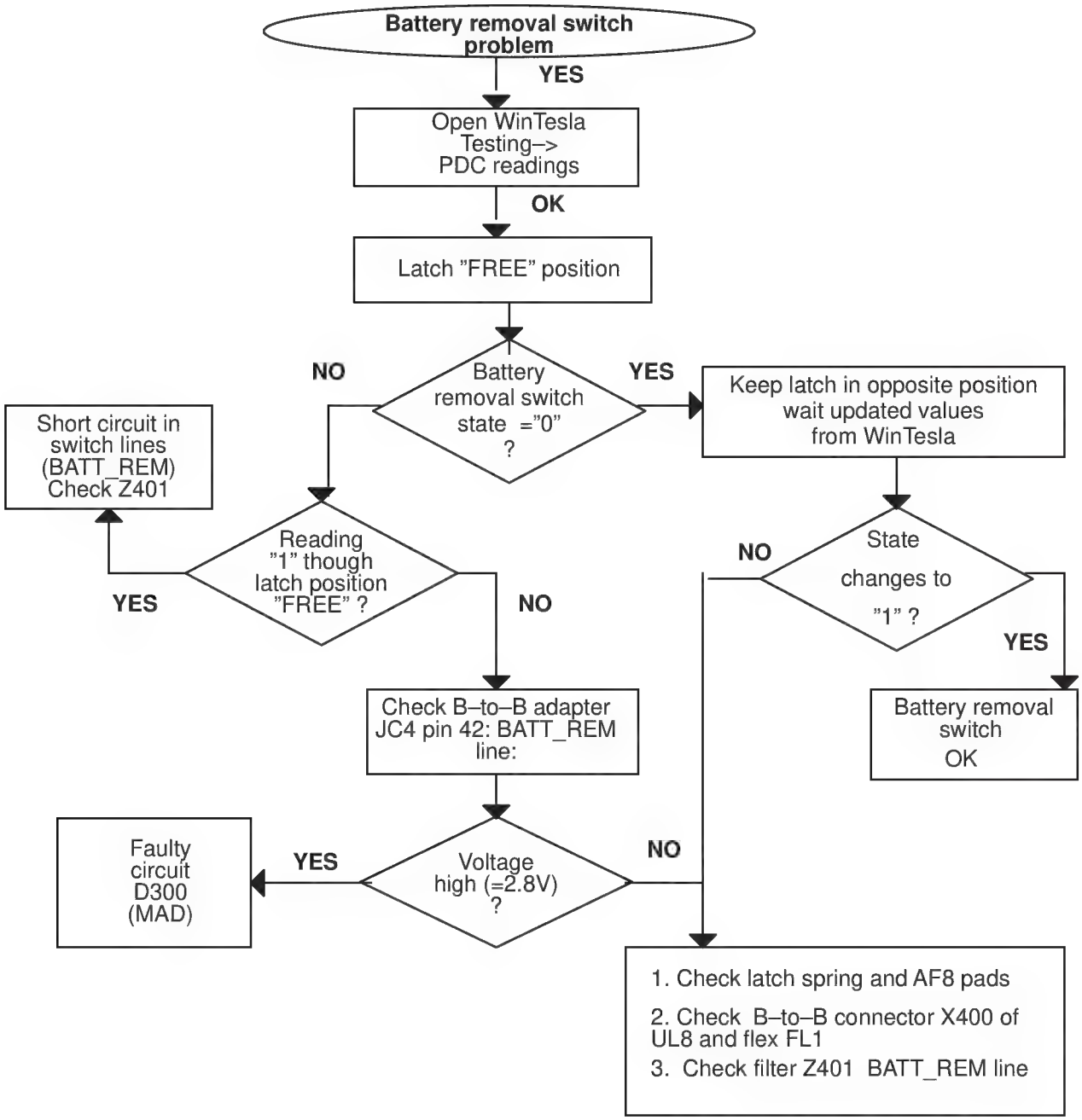

Battery removal switch problem
YES
Open WinTesla Testing–> PDC readings
OK
Latch "FREE" position
Battery removal switch state ="0" ?
NO
YES
Short circuit in switch lines (BATT_REM) Check Z401
Keep latch in opposite position wait updated values from WinTesla
Reading "1" though latch position "FREE" ?
YES
NO
State changes to "1" ?
NO
YES
Check B–to–B adapter JC4 pin 42: BATT_REM line:
Battery removal switch OK
Faulty circuit D300 (MAD)
YES
Voltage high (=2.8V) ?
NO
1. Check latch spring and AF8 pads
2. Check B–to–B connector X400 of UL8 and flex FL1
3. Check filter Z401 BATT_REM line

Figure 43.

2.17 COBBA Control Interface troubleshooting

NOTE: If there are problems in COBBA serial interface, self tests fail and there is "Contact service" shown on the display. Wintesla shows fails at "Cobba parallel".

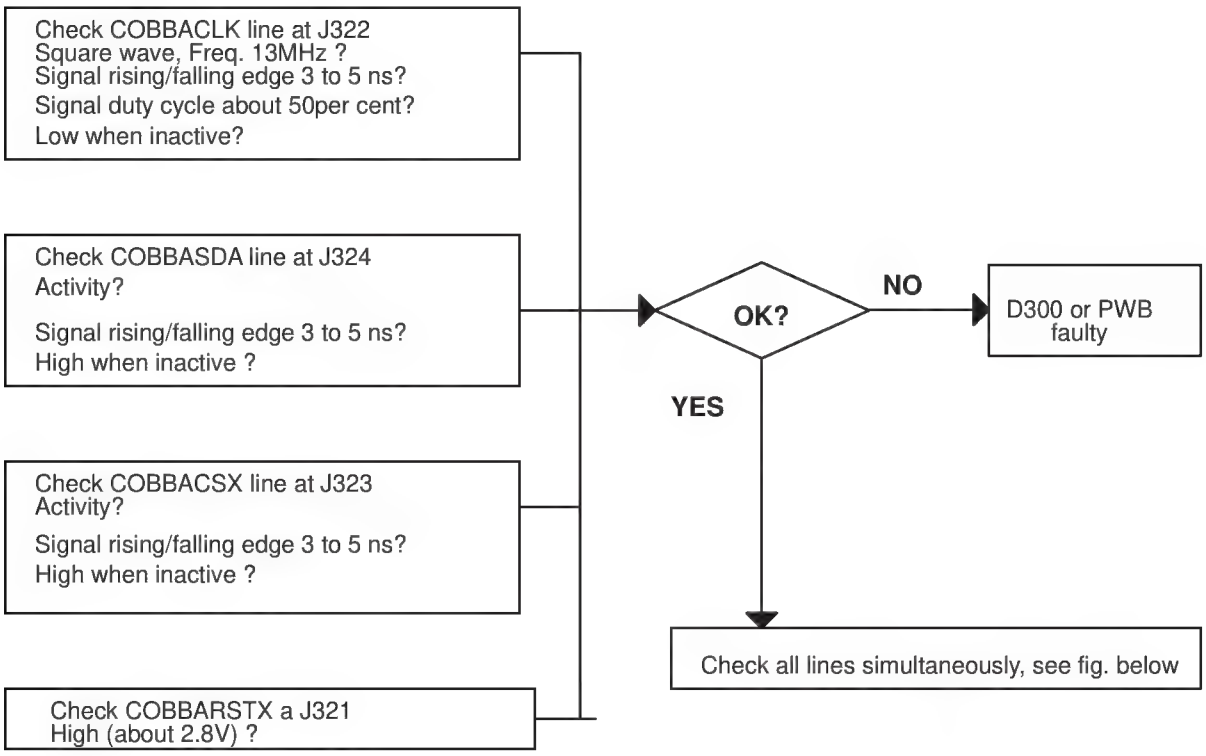

Check COBBACLK line at J322
Square wave, Freq. 13MHz ?
Signal rising/falling edge 3 to 5 ns?
Signal duty cycle about 50per cent?
Low when inactive?
Check COBBASDA line at J324
Activity?
Signal rising/falling edge 3 to 5 ns?
High when inactive ?
Check COBBACSX line at J323
Activity?
Signal rising/falling edge 3 to 5 ns?
High when inactive ?
Check COBBARSTX a J321
High (about 2.8V) ?
OK?
NO
D300 or PWB faulty
YES
Check all lines simultaneously, see fig. below

Figure 44.

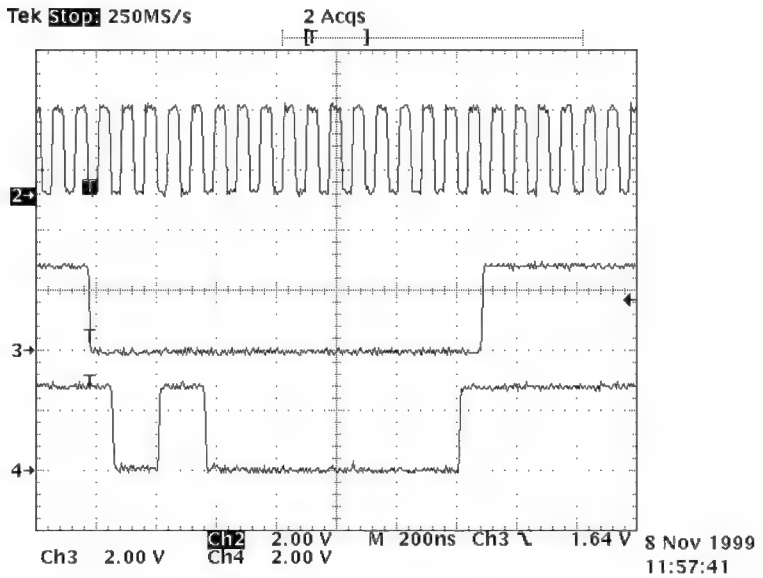


Figure 45. Write sequence to COBBA.

Figure 45 is a write sequence to COBBA. There should be non–all–zero writes to COBBA.

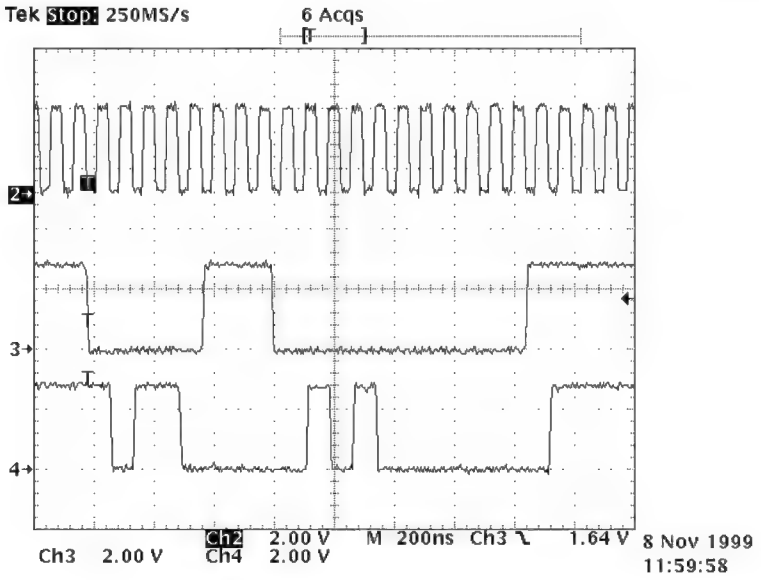


Figure 46. COBBA read

Figure 46 is a COBBA read.

The MADLinda writes first the address to be read, deactivates the COBBACSX line and then activates the COBBACSX line again. Then the COBBA_GJP sends the requested data. There should be non–zero reads.

If no non–zero reads from COBBA can be seen, COBBA (N200) may be faulty.

If both reads and writes of non–zero values can be seen and the signal characteristics were good, the COBBA serial control interface is working correctly.

2.18 COBBA PCM Interface Troubleshooting

PCM interface transfers digital audio data. Problems in this interface result in missing or flawed audio in either or both in uplink and downlink directions. If Wintesla shows errors in "COBBA serial interface", PCM interface is faulty.

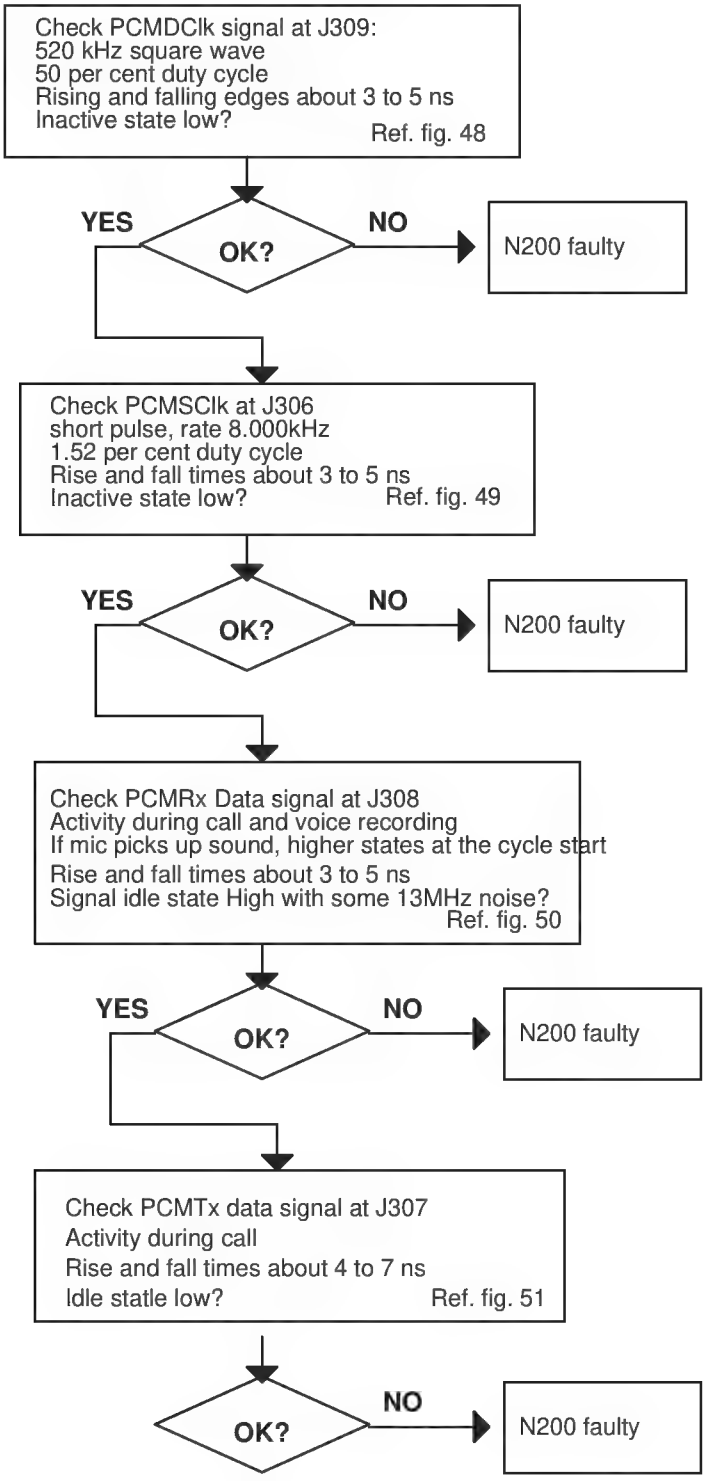


Figure 47.

There is no traffic in PCM interface without a call or audio play (voice recorder, video player, etc). These signals can be measured with a call, which generates

traffic in both directions. Audio play generates traffic in one direction only. Recording audio (voice recorder) generates traffic in the other direction.

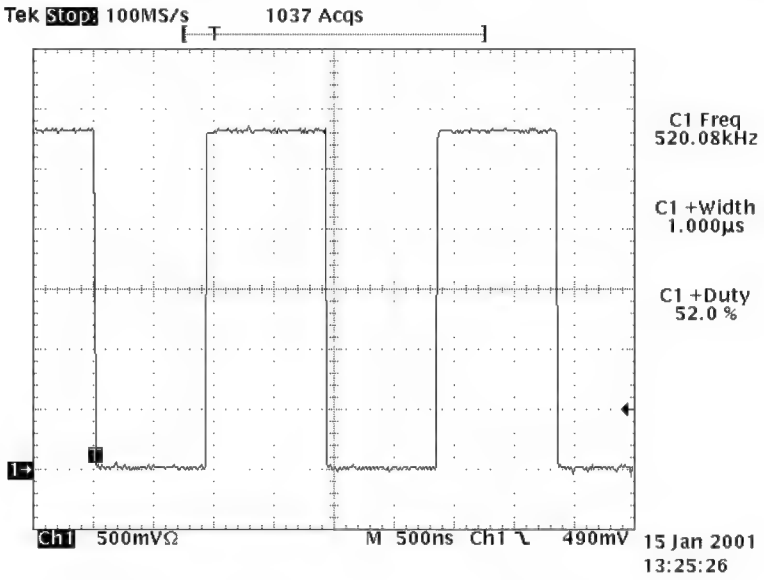


Figure 48. PCMDClk signal at J309

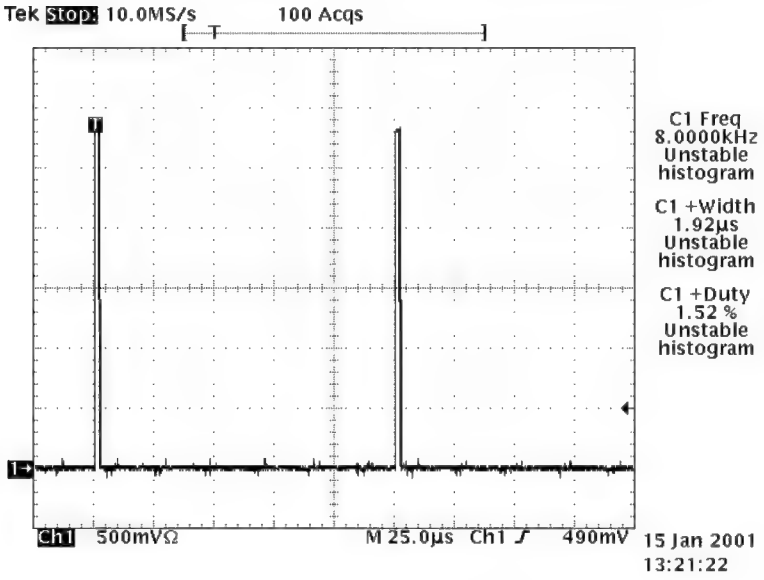


Figure 49. PCMSClk signal at J306.

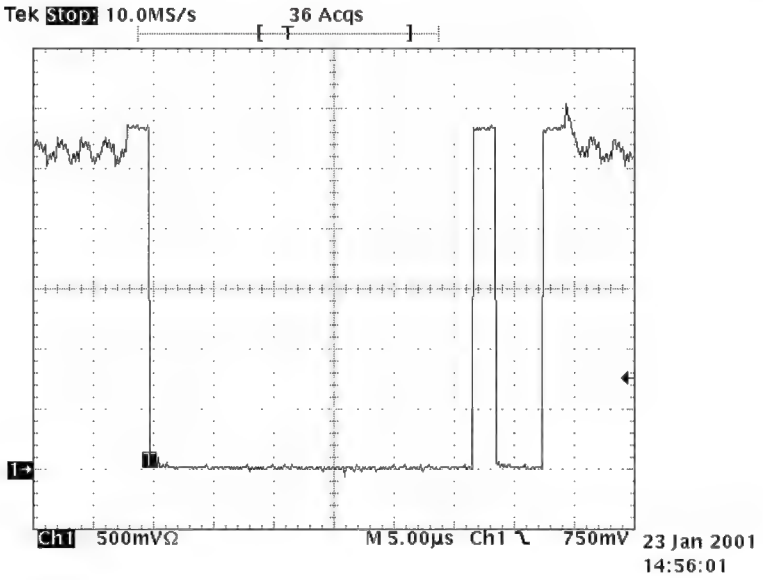


Figure 50. PCMRxData signal at J308.

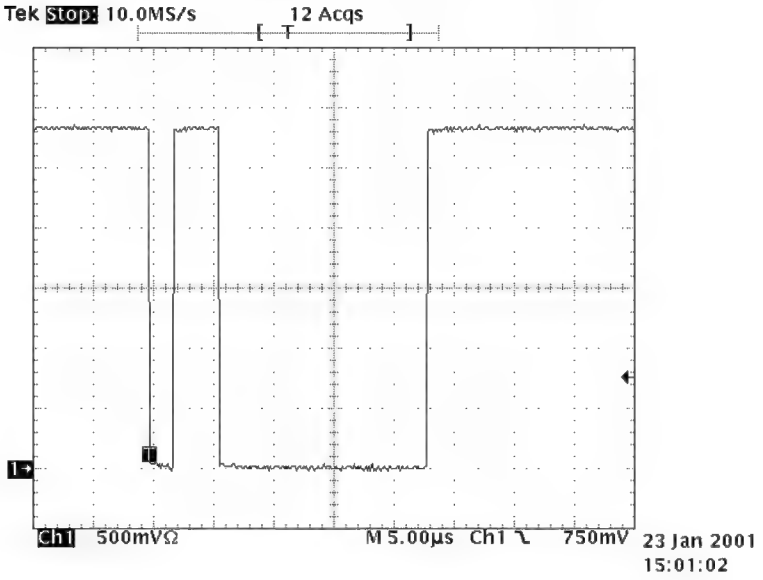
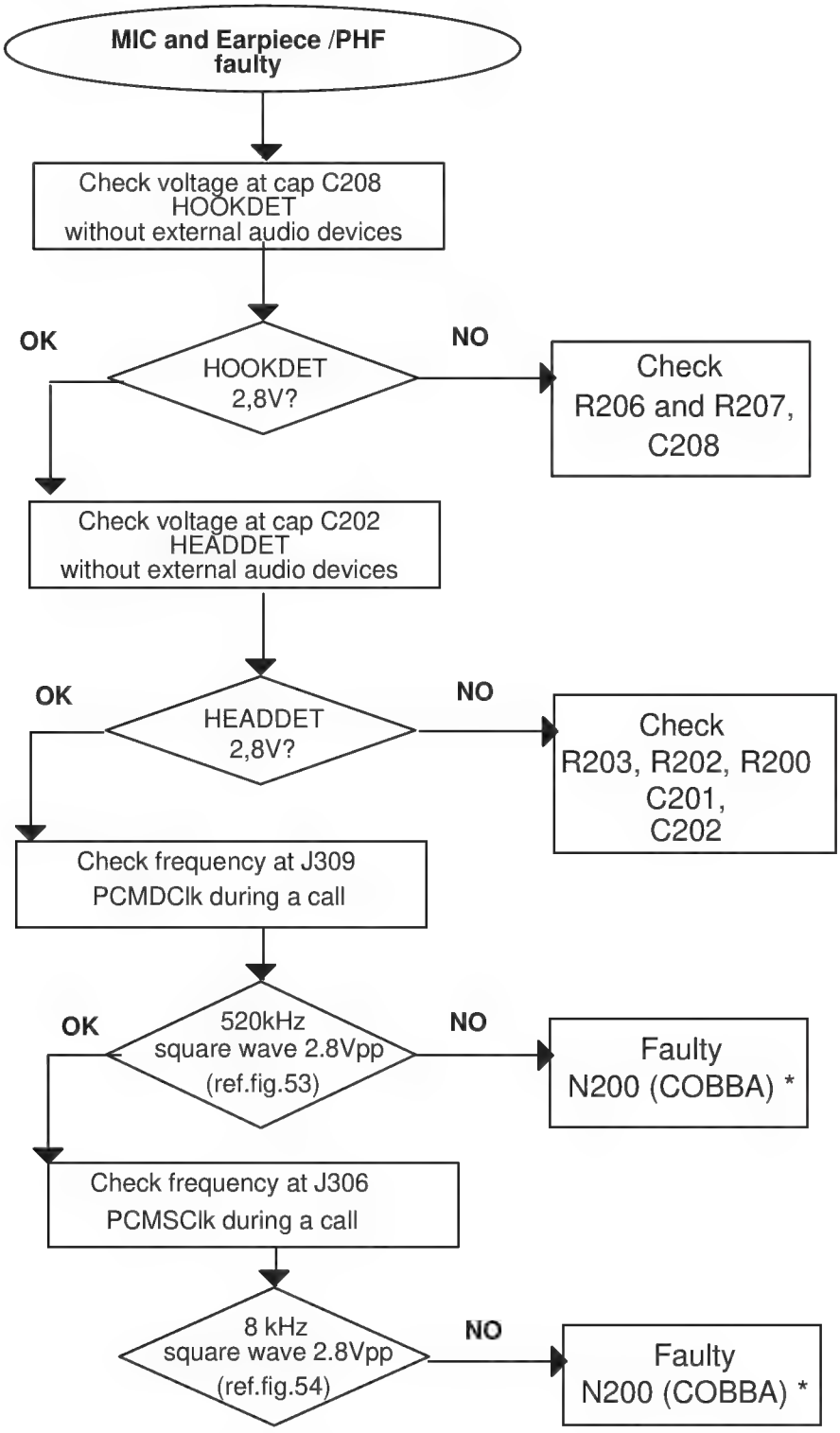


Figure 51. PCMTxData signal at J307

PCMTxData signal at J307 (Figure 51). This signal comes from the other end's microphone or audio playing software (voice recorder, video player etc) and is targeted for the earpiece or hands free speaker. There should be activity during a call. Signal rise and fall times are around 4–7ns. Idle state is low.

2.19 Audio troubleshooting

2.19.1 Both Mic and Earpiece/PHF faulty


MIC and Earpiece /PHF faulty
Check voltage at cap C208 HOOKDET without external audio devices
OK
HOOKDET 2,8V?
NO
Check R206 and R207, C208
Check voltage at cap C202 HEADDET without external audio devices
OK
HEADDET 2,8V?
NO
Check R203, R202, R200 C201, C202
Check frequency at J309 PCMDClk during a call
OK
520kHz square wave 2.8Vpp (ref.fig.53)
NO
Faulty N200 (COBBA) *
Check frequency at J306 PCMSClk during a call
8 kHz square wave 2.8Vpp (ref.fig.54)
NO
Faulty N200 (COBBA) *

* refer to section 2.17 in this document

Figure 52. PCMDClk

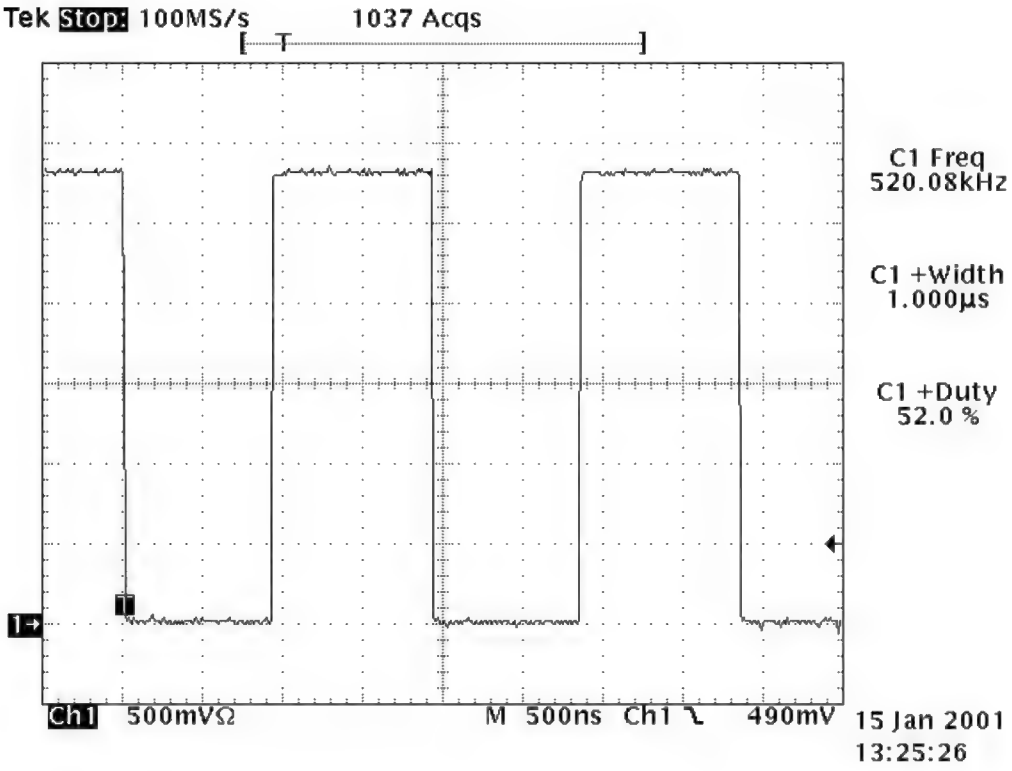


Figure 53. PCDClk

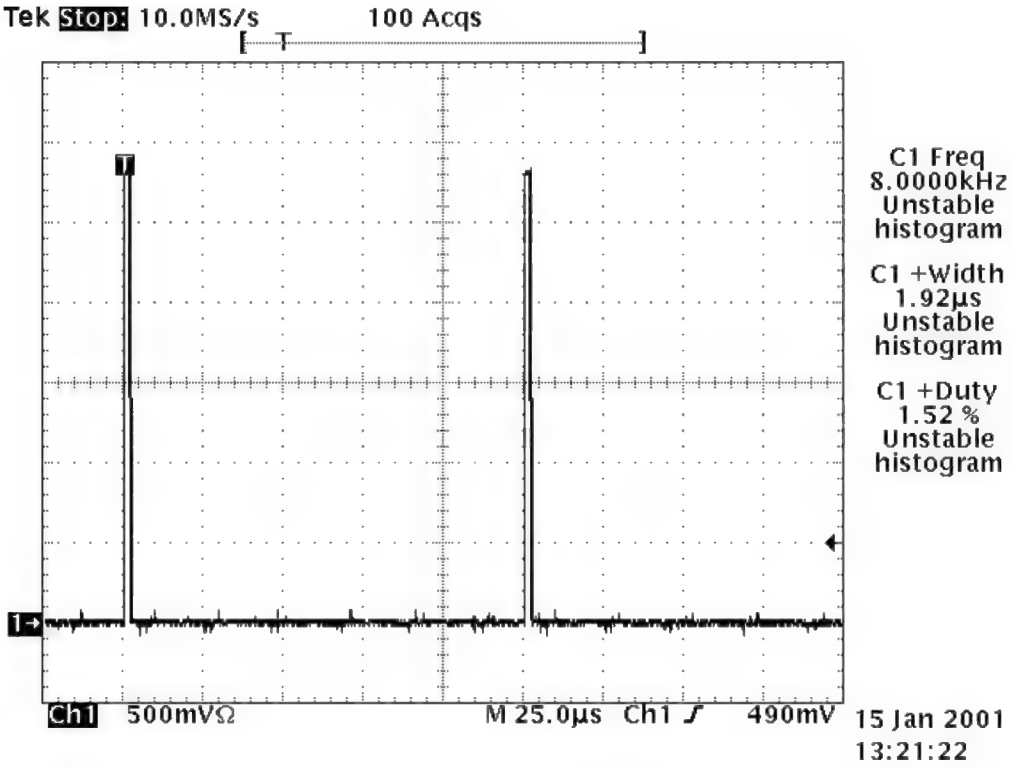


Figure 54. PCMSClk

2.19.2 Mic faulty

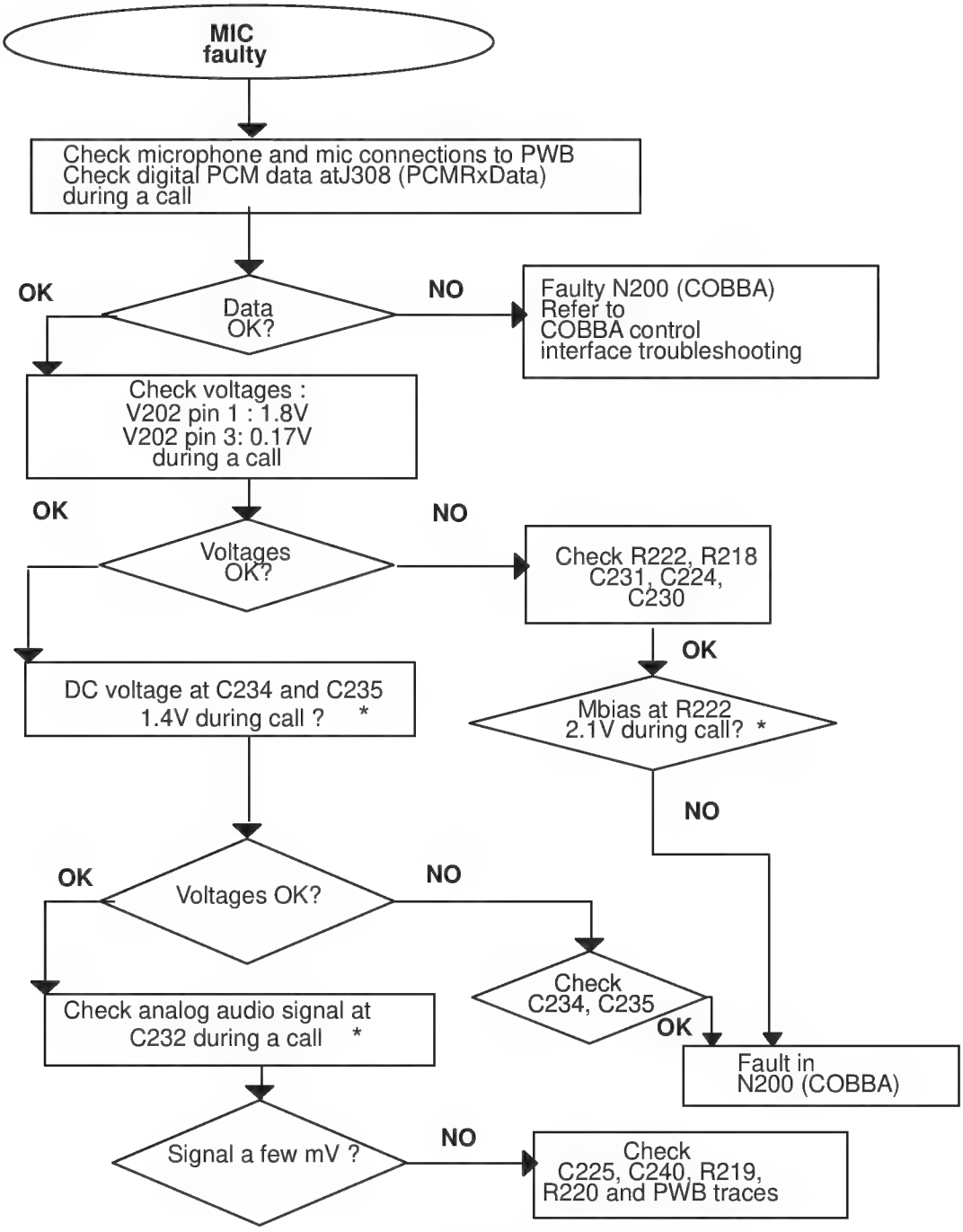


Figure 55.

Note:* can not be measured in the service jig, because components are under the SIM connector.

Use wire to measure them. After removing measurement wire, check that components are not defected. It is recommended to replace the components.

2.19.3 Earpiece faulty

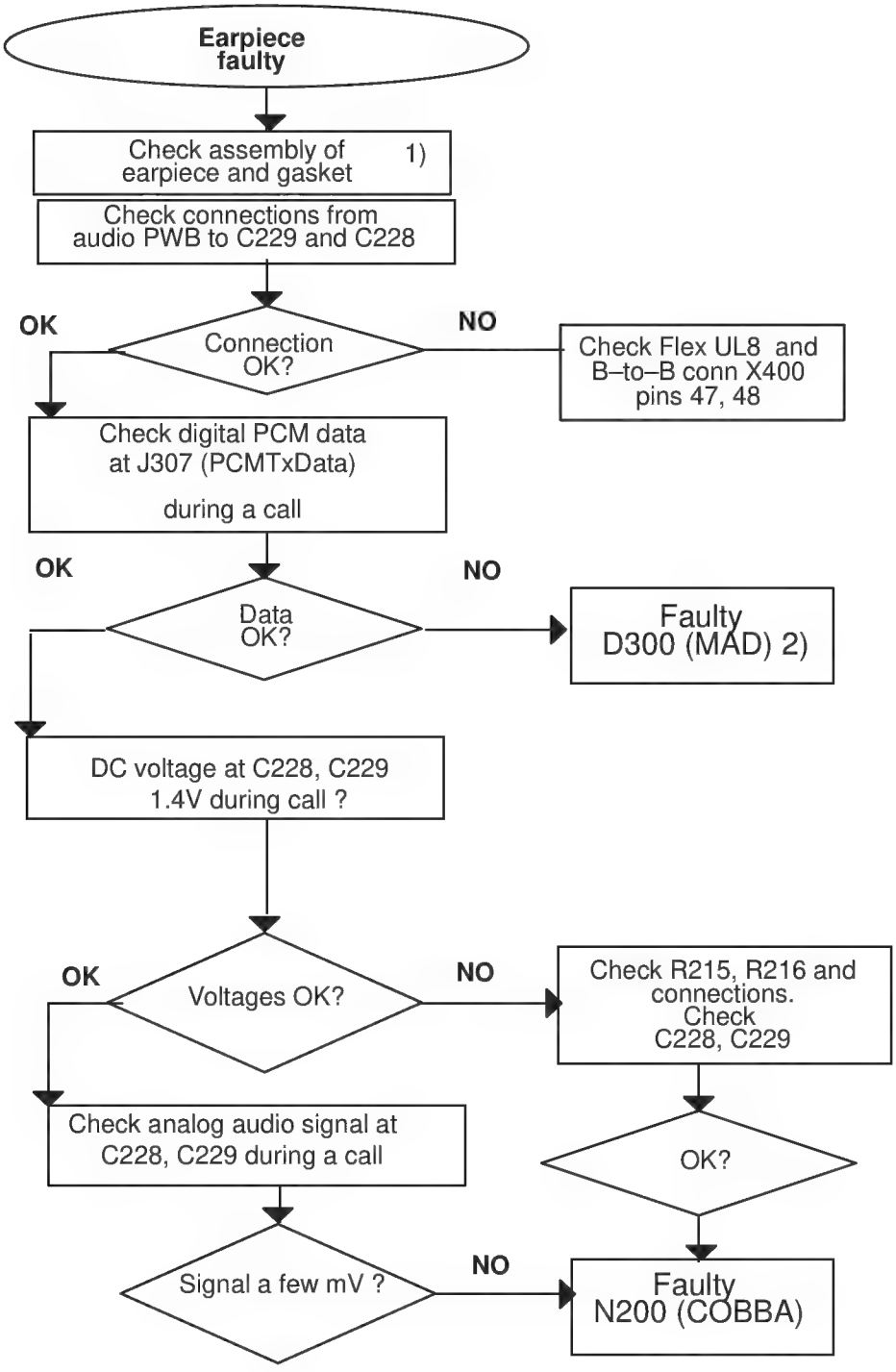

Earpiece faulty
Check assembly of earpiece and gasket 1)
Check connections from audio PWB to C229 and C228
OK
Connection OK?
NO
Check Flex UL8 and B–to–B conn X400 pins 47, 48
Check digital PCM data at J307 (PCMTxData) during a call
OK
Data OK?
NO
Faulty D300 (MAD) 2)
DC voltage at C228, C229 1.4V during call ?
OK
Voltages OK?
NO
Check R215, R216 and connections. Check C228, C229
Check analog audio signal at C228, C229 during a call
OK?
Signal a few mV ?
NO
Faulty N200 (COBBA)

Figure 56.

Note:

1) If sound is distorted or too quiet fault is most probably in the gasket or in the earpiece diaphragm.

2) Refer to section 2.16 in this document.

2.19.4 PHF Speaker faulty

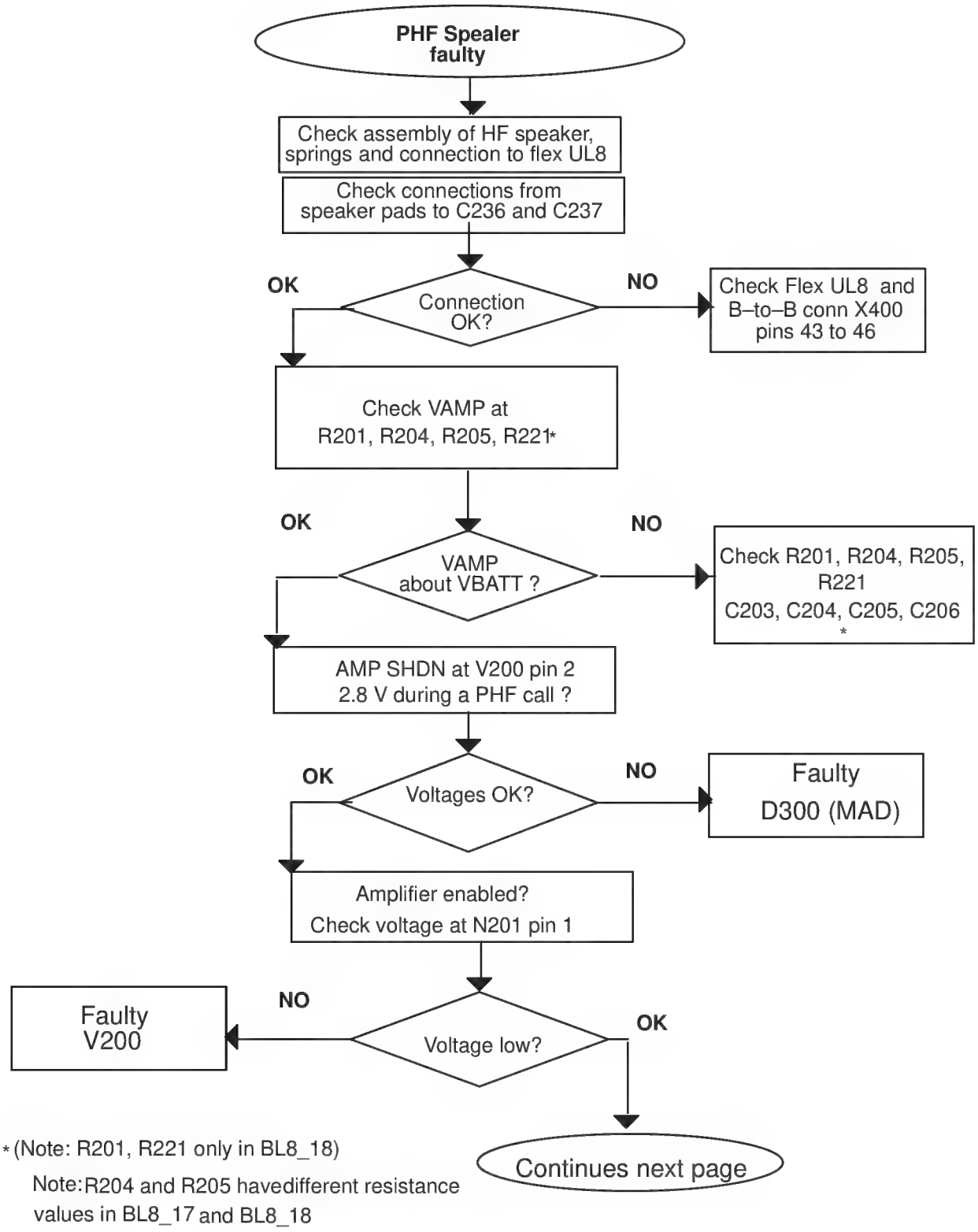

PHF Spealer faulty
Check assembly of HF speaker, springs and connection to flex UL8
Check connections from speaker pads to C236 and C237
OK
Connection OK?
NO
Check Flex UL8 and B–to–B conn X400 pins 43 to 46
Check VAMP at R201, R204, R205, R221*
OK
VAMP about VBATT ?
NO
Check R201, R204, R205, R221 C203, C204, C205, C206 *
AMP SHDN at V200 pin 2 2.8 V during a PHF call ?
OK
Voltages OK?
NO
Faulty D300 (MAD)
Amplifier enabled? Check voltage at N201 pin 1
Faulty V200
NO
Voltage low?
OK
Continues next page
* (Note: R201, R221 only in BL8_18)
Note: R204 and R205 havedifferent resistance values in BL8_17 and BL8_18

Figure 57.

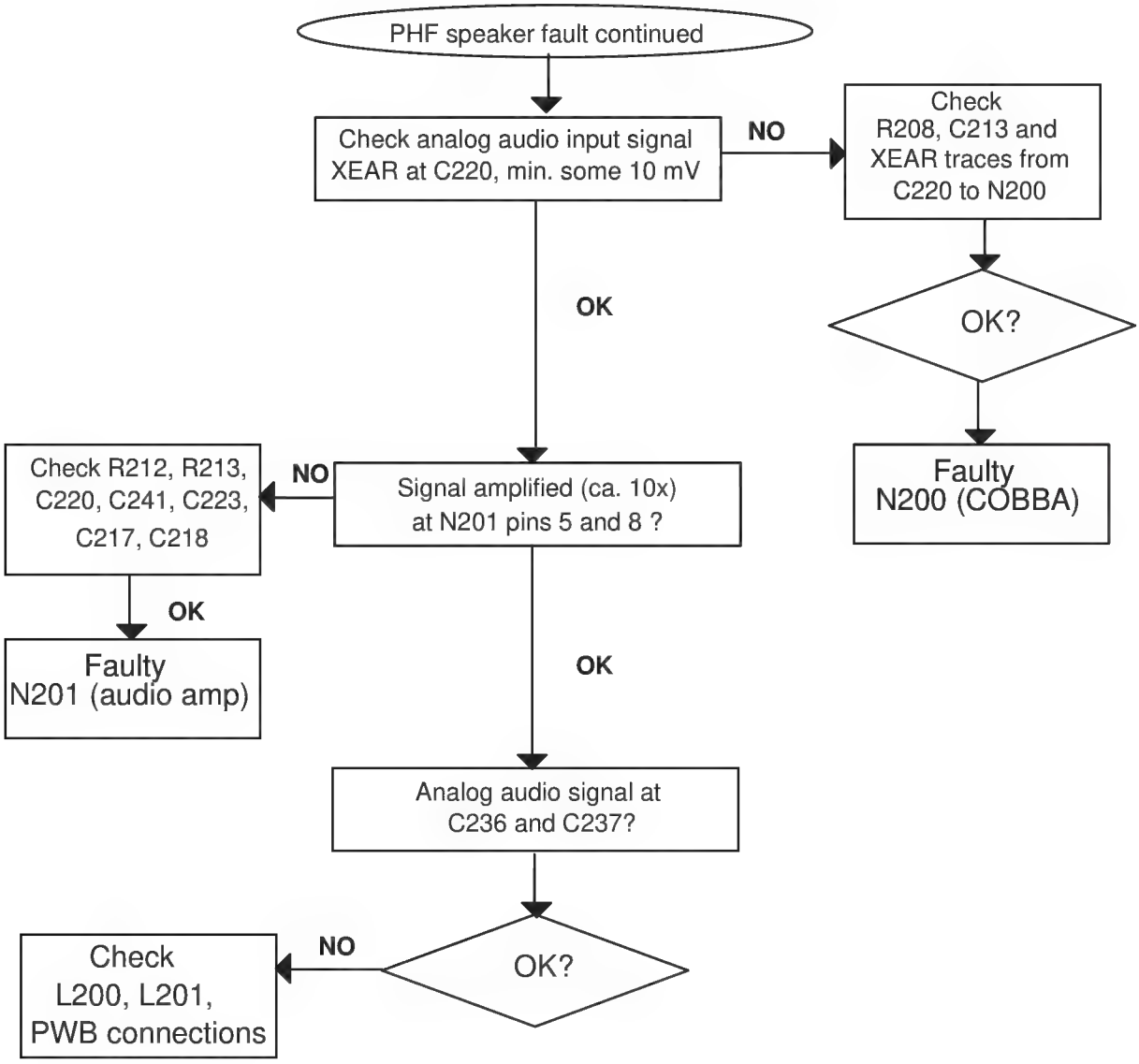

PHF speaker fault continued
Check analog audio input signal XEAR at C220, min. some 10 mV
NO
Check R208, C213 and XEAR traces from C220 to N200
OK?
Faulty N200 (COBBA)
OK
Check R212, R213, C220, C241, C223, C217, C218
NO
Signal amplified (ca. 10x) at N201 pins 5 and 8 ?
OK
Faulty N201 (audio amp)
OK
Analog audio signal at C236 and C237?
Check L200, L201, PWB connections
NO
OK?

Figure 58.

2.19.5 Headset out of order

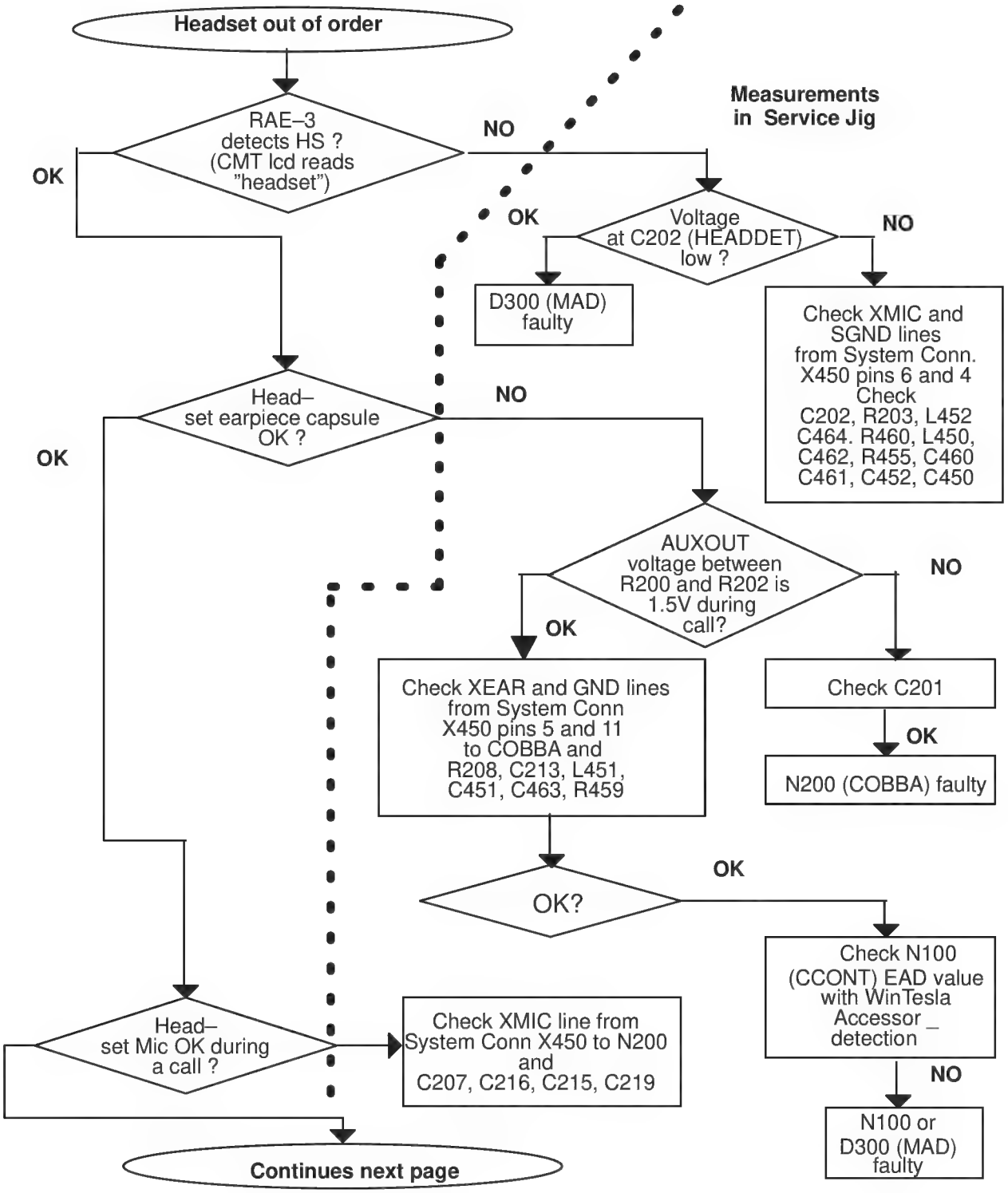

Headset out of order
RAE–3 detects HS ? (CMT lcd reads "headset")
NO
OK
Measurements in Service Jig
OK
Voltage at C202 (HEADDET) low ?
NO
D300 (MAD) faulty
Check XMIC and SGND lines from System Conn. X450 pins 6 and 4 Check C202, R203, L452 C464. R460, L450, C462, R455, C460 C461, C452, C450
Head– set earpiece capsule OK ?
NO
OK
AUXOUT voltage between R200 and R202 is 1.5V during call?
NO
OK
Check XEAR and GND lines from System Conn X450 pins 5 and 11 to COBBA and R208, C213, L451, C451, C463, R459
Check C201
OK
N200 (COBBA) faulty
OK?
OK
Check N100 (CCONT) EAD value with WinTesla Accessor _ detection
NO
N100 or D300 (MAD) faulty
Head– set Mic OK during a call ?
Check XMIC line from System Conn X450 to N200 and C207, C216, C215, C219
Continues next page

Figure 59.

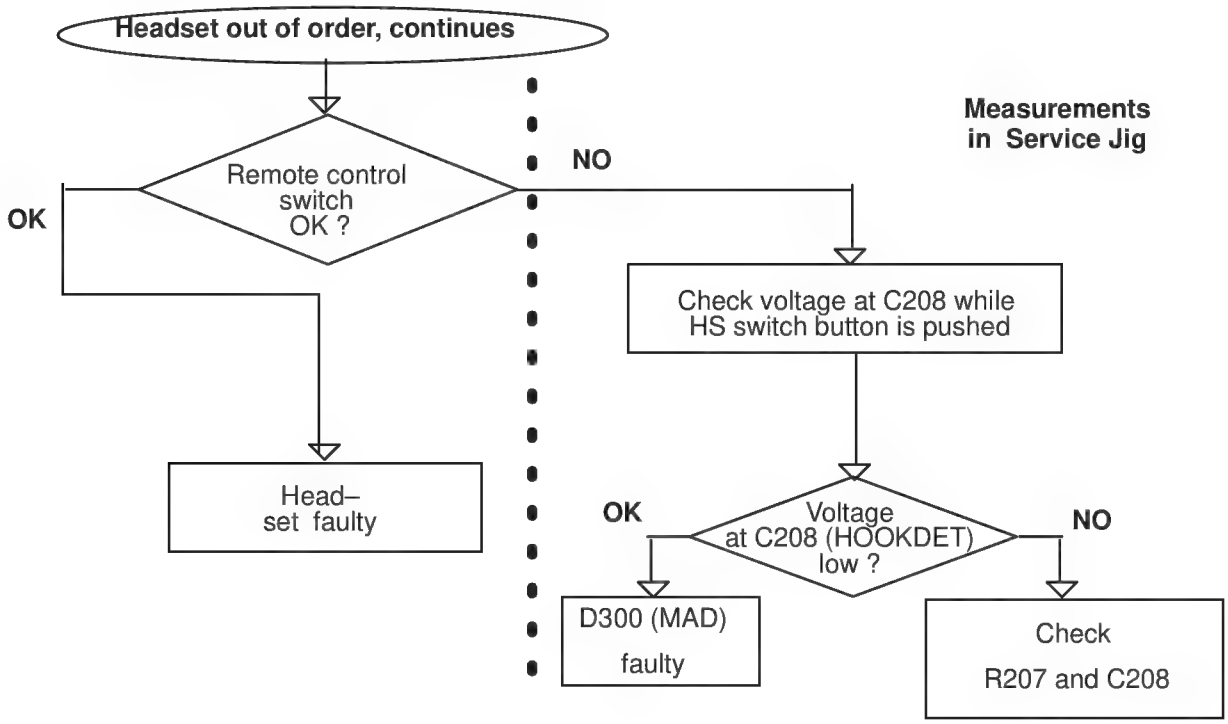

Headset out of order, continues
Measurements in Service Jig
Remote control switch OK ?
NO
OK
Check voltage at C208 while HS switch button is pushed
Head– set faulty
OK
Voltage at C208 (HOOKDET) low ?
NO
D300 (MAD) faulty
Check R207 and C208

Figure 60.

2.20 RF Interface

2.20.1 Phone doesn't register to the network or doesn't make a call

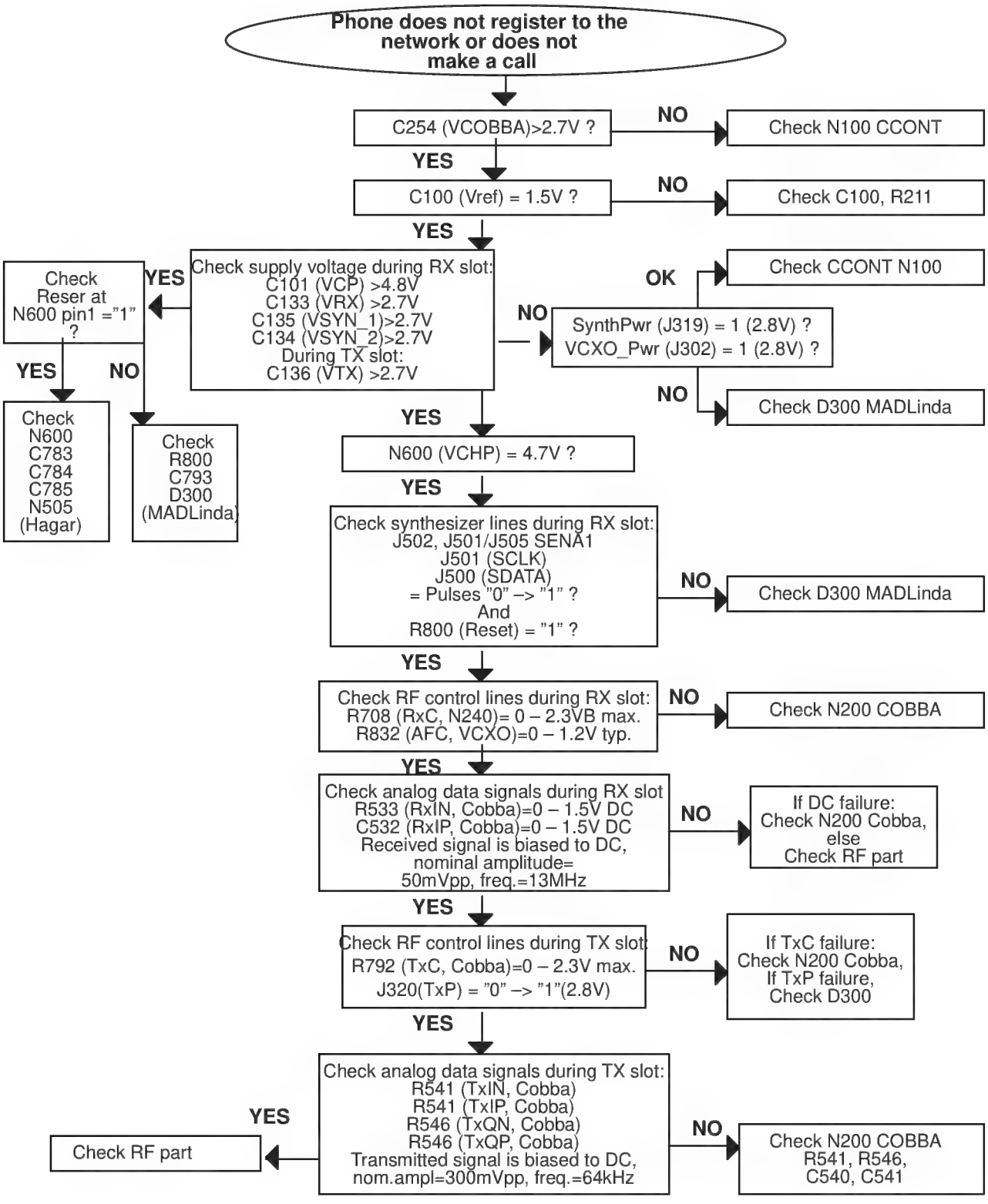


Figure 61.

2.21 IR Interface Troubleshooting diagram

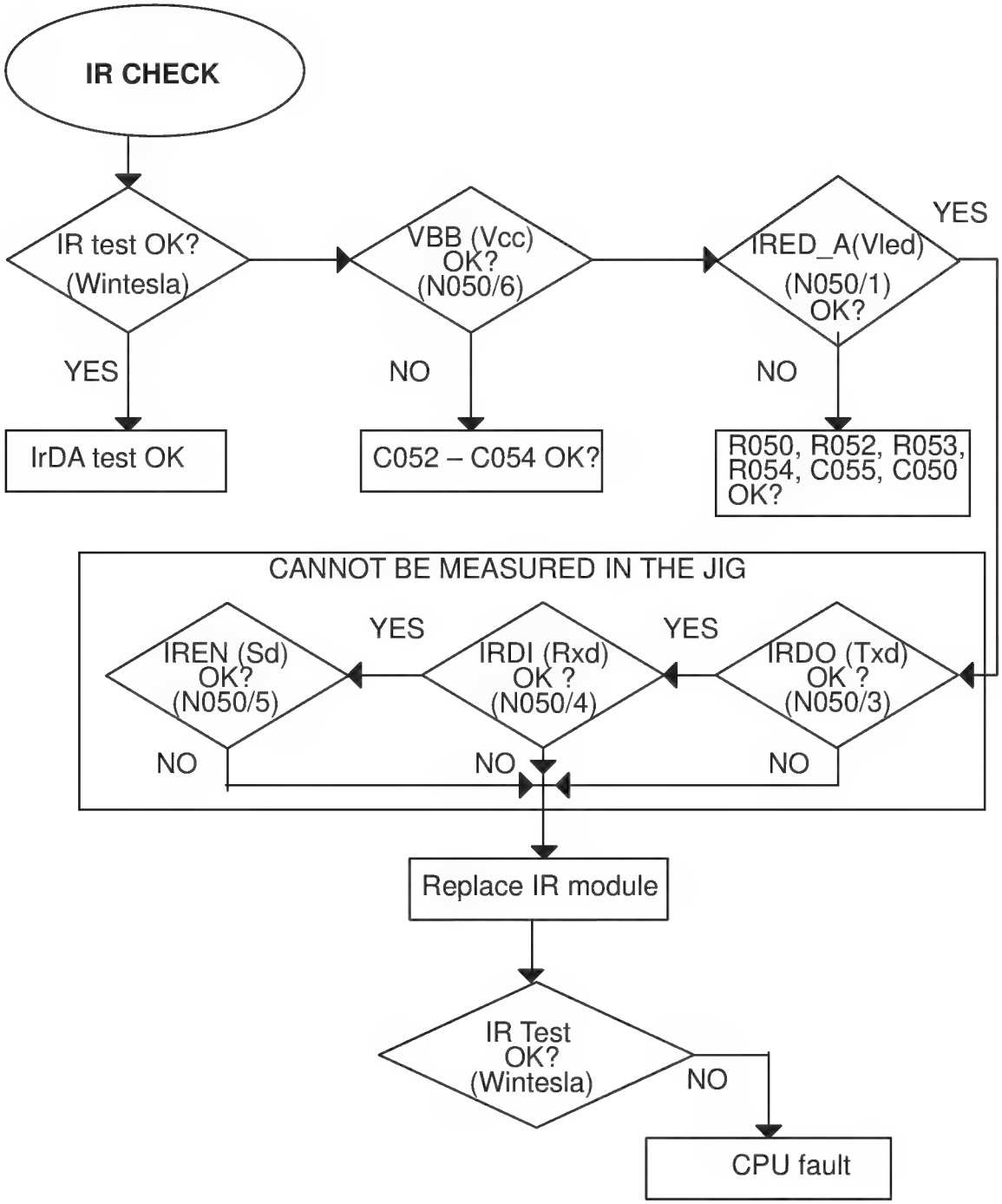


Figure 62.

2.22 BL8 related Keyboard problems

There may be several types of problems with keyboard. Usually some of the keys (CMT and PDA) are not working, or several key presses happen simultaneously.

If CMT informs "Please close cover", see "Lid switch problems" section.

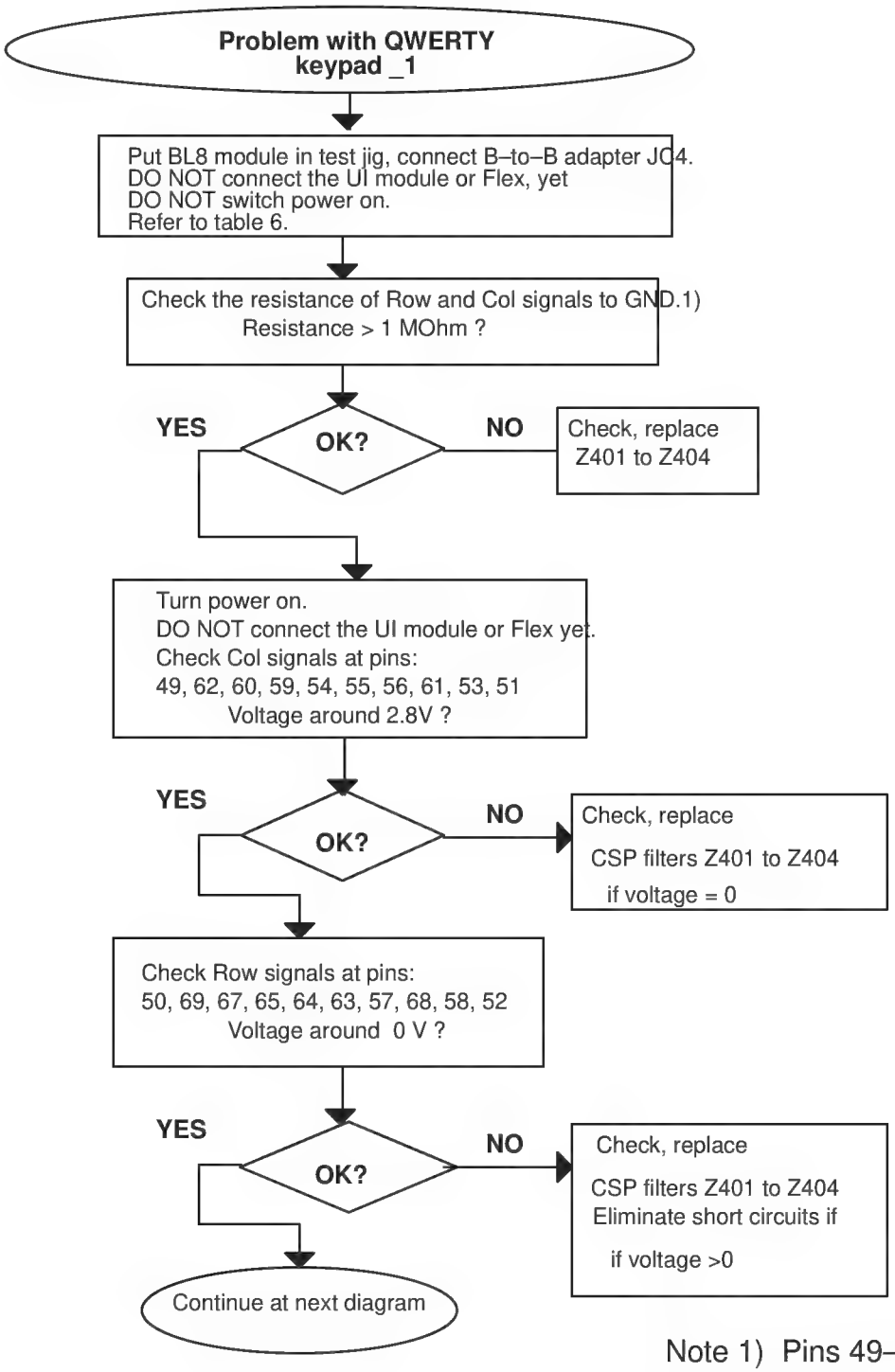

Problem with QWERTY keypad _1
Put BL8 module in test jig, connect B–to–B adapter JC4.
DO NOT connect the UI module or Flex, yet
DO NOT switch power on.
Refer to table 6.
Check the resistance of Row and Col signals to GND.1)
Resistance > 1 MOhm ?
YES
OK?
NO
Check, replace
Z401 to Z404
Turn power on.
DO NOT connect the UI module or Flex yet.
Check Col signals at pins:
49, 62, 60, 59, 54, 55, 56, 61, 53, 51
Voltage around 2.8V ?
YES
OK?
NO
Check, replace
CSP filters Z401 to Z404
if voltage = 0
Check Row signals at pins:
50, 69, 67, 65, 64, 63, 57, 68, 58, 52
Voltage around 0 V ?
YES
OK?
NO
Check, replace
CSP filters Z401 to Z404
Eliminate short circuits if
if voltage >0
Continue at next diagram
Note 1) Pins 49–65 and
66–69 against pin 70 (gnd).

Figure 63.

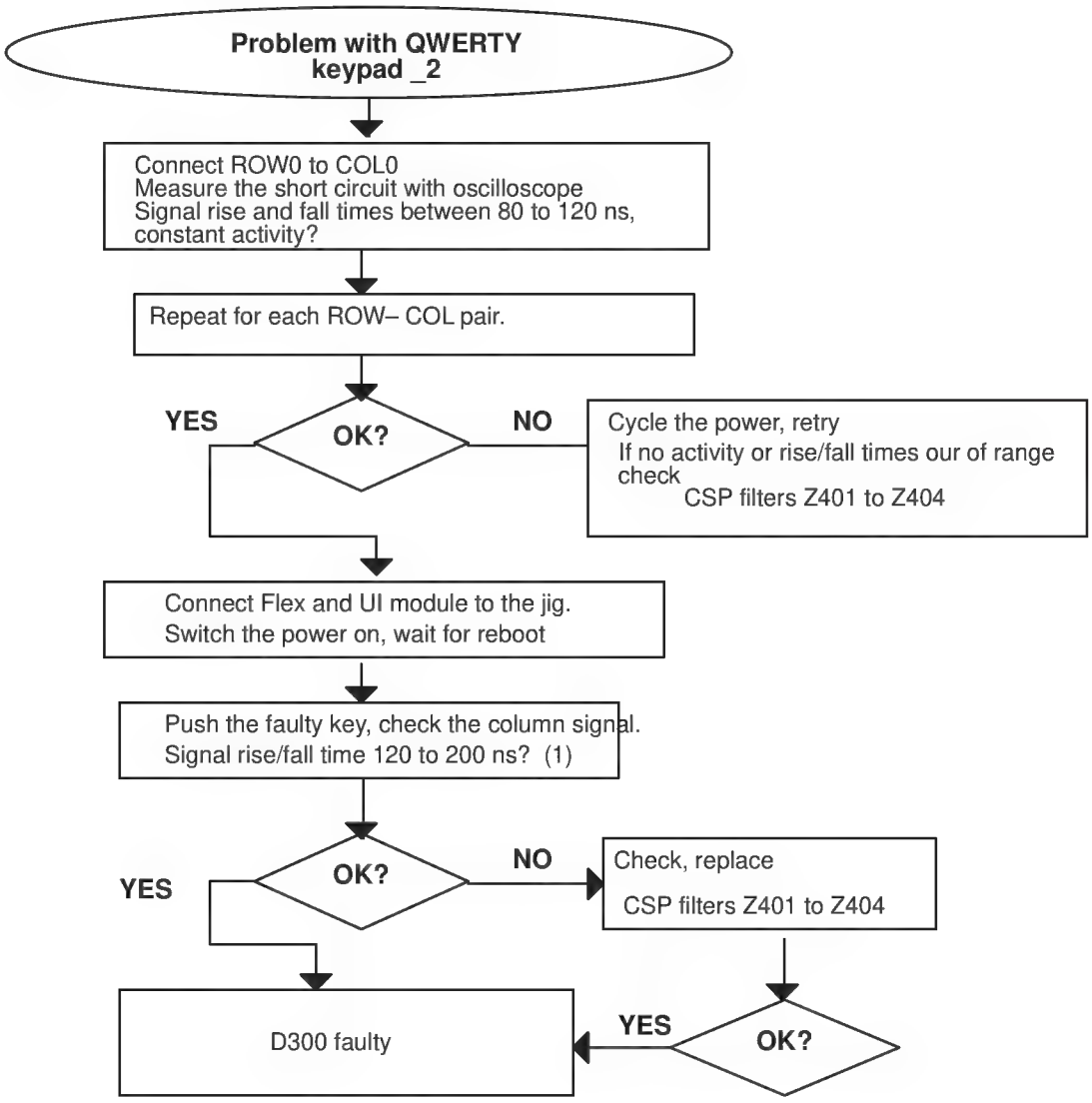

Problem with QWERTY keypad _2
Connect ROW0 to COL0
Measure the short circuit with oscilloscope
Signal rise and fall times between 80 to 120 ns, constant activity?
Repeat for each ROW– COL pair.
YES
OK?
NO
Cycle the power, retry
If no activity or rise/fall times our of range check
CSP filters Z401 to Z404
Connect Flex and UI module to the jig.
Switch the power on, wait for reboot
Push the faulty key, check the column signal.
Signal rise/fall time 120 to 200 ns? (1)
YES
OK?
NO
Check, replace
CSP filters Z401 to Z404
D300 faulty
YES
OK?

Figure 64.

Table 1. Keyboard matrix (keys on UL2 module highlighted) – English keymat

	Col0	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8	Col9
Row0	cmt Soft1	cmt Up	cmt Soft2	pda Soft 3	pda Soft 1			Space	Info <	/ >
Row1	cmt Send	cmt Down	cmt End	pda Soft 4	pda Soft 2		Z	Shift	C	B
Row2	cmt 1	cmt 2	cmt 3	cmt Profile	cmt Power		Chr	N	M	, @
Row3	cmt 4	cmt 5	cmt 6	cmt *	cmt #	Menu	Up	Right	Down	Left
Row4	cmt 7	cmt 8	cmt 9	cmt 0		:;	+–	Back-space		Enter
Row5	ESC	App1	App2	App3	app4	App6	App7	App8		
Row6		Ctrl	V	X	6	App5				
Row7	1	2	3	4	5	7	8	9	0	P
Row8	Tab	Q	W	E	R	T	Y	U	I	O
Row9	Caps	A	S	D	F	G	H	J	K	L

Table 2. Keyboard line filters

Z402	Z403	Z404
Col4	Col1	Row1
Col5	Col2	Row2
Col6	Col3	Row3
Col8	Col7	Row4
Col9	Row5	Row7
Row9	Row6	
	Row8	

2.23 BL8 related PDA UI problems

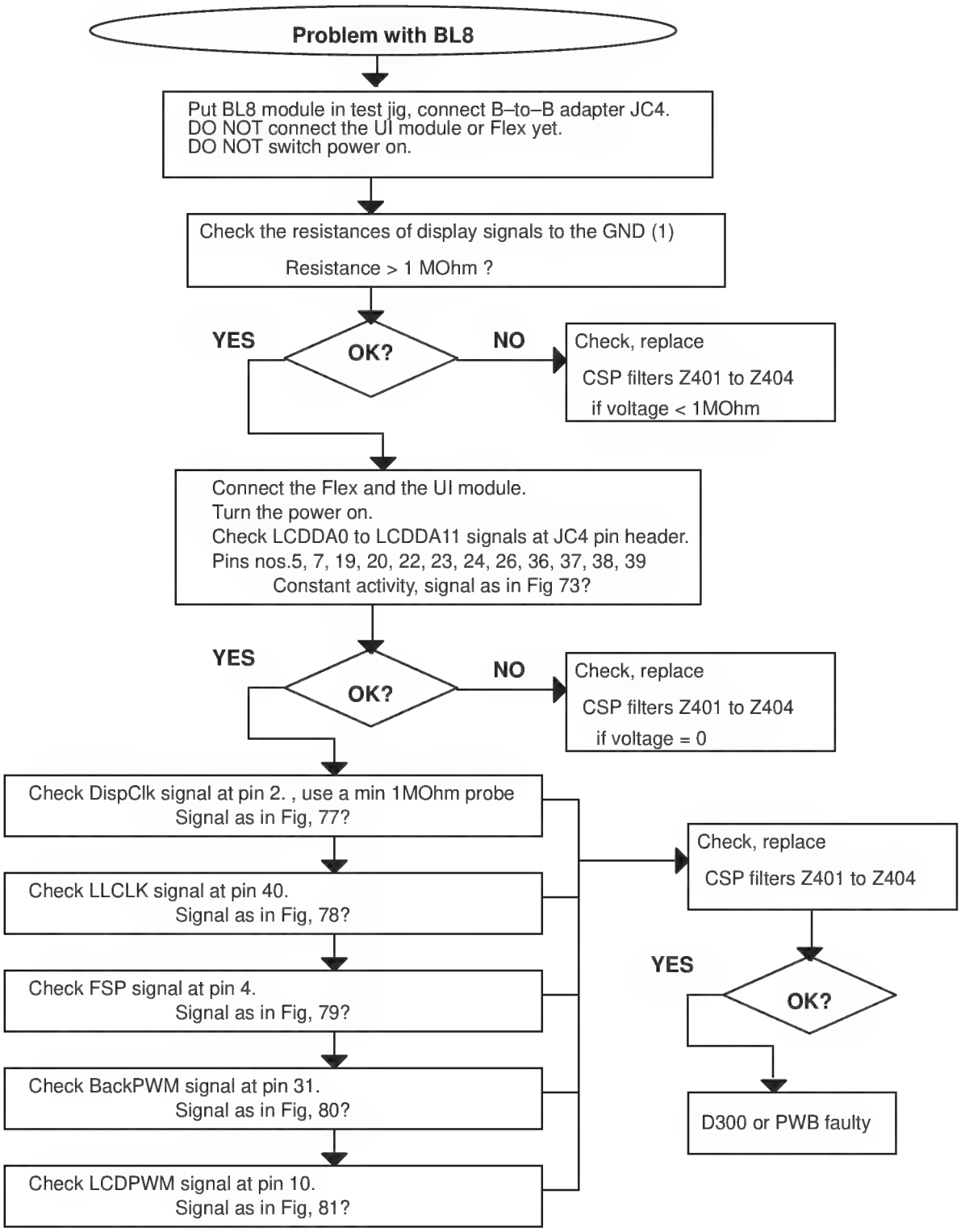

Problem with BL8
Put BL8 module in test jig, connect B–to–B adapter JC4.
DO NOT connect the UI module or Flex yet.
DO NOT switch power on.
Check the resistances of display signals to the GND (1)
Resistance > 1 MOhm ?
YES
OK?
NO
Check, replace
CSP filters Z401 to Z404
if voltage < 1MOhm
Connect the Flex and the UI module.
Turn the power on.
Check LCDDA0 to LCDDA11 signals at JC4 pin header.
Pins nos.5, 7, 19, 20, 22, 23, 24, 26, 36, 37, 38, 39
Constant activity, signal as in Fig 73?
YES
OK?
NO
Check, replace
CSP filters Z401 to Z404
if voltage = 0
Check DispClk signal at pin 2. , use a min 1MOhm probe
Signal as in Fig, 77?
Check LLCLK signal at pin 40.
Signal as in Fig, 78?
Check FSP signal at pin 4.
Signal as in Fig, 79?
Check BackPWM signal at pin 31.
Signal as in Fig, 80?
Check LCDPWM signal at pin 10.
Signal as in Fig, 81?
Check, replace
CSP filters Z401 to Z404
YES
OK?
D300 or PWB faulty

Figure 65.

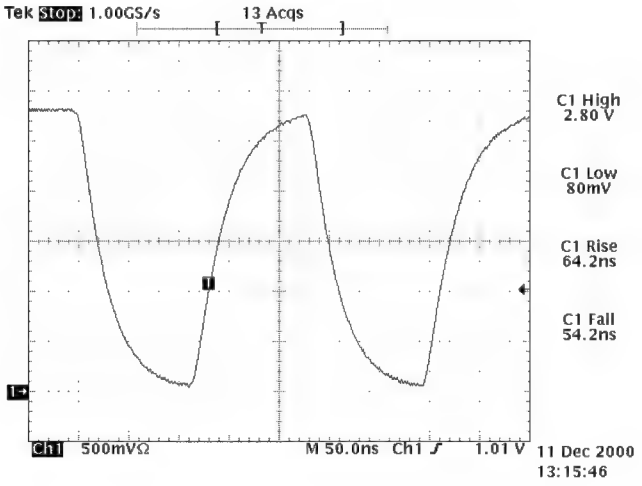


Figure 66. LCDDA0–LCDDA11 signals on the pin header on JC4. The pins are 5, 7, 19, 20, 22–24, 26, 36–39.

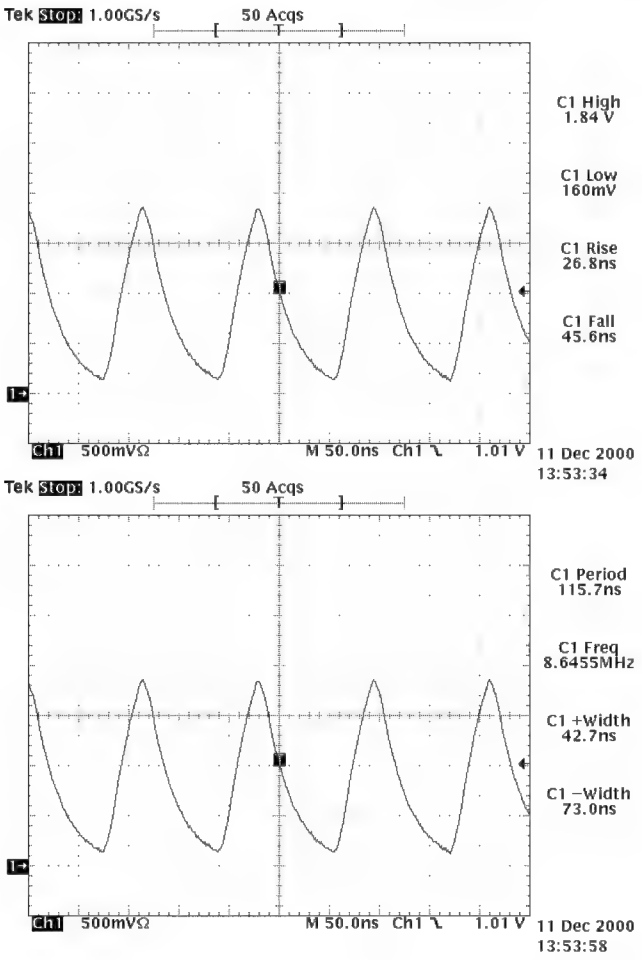


Figure 67. DispClk signal at pin 2

DispClk signal (Figure 67) at pin 2. Use at least 1MΩ probe for this.
Note: The more critical values are high 1.8V, frequency 8.645MHz and +Width 42ns. If the signal high time is too small, it will cause errors.

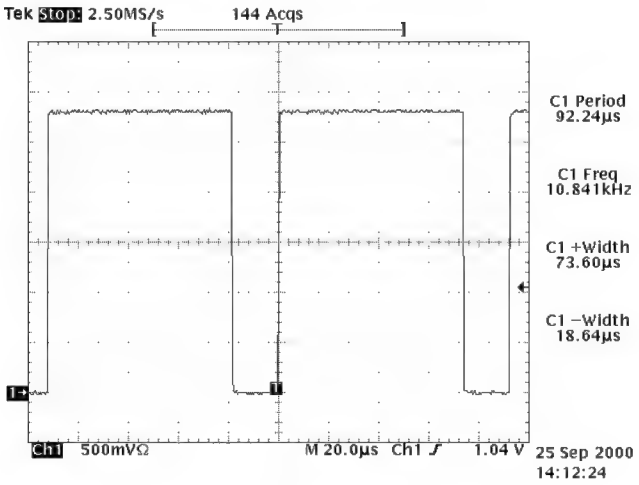


Figure 68. LLCLK signal at pin 40.

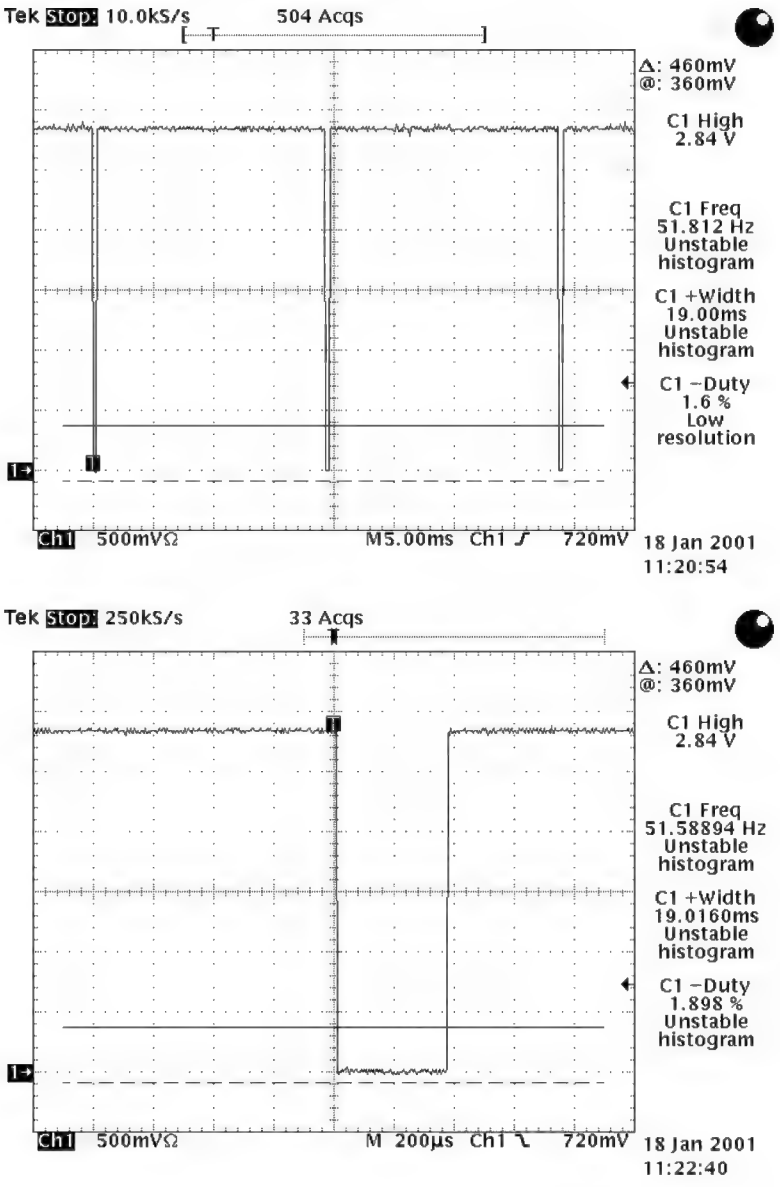


Figure 69. FSP signal at pin 4.

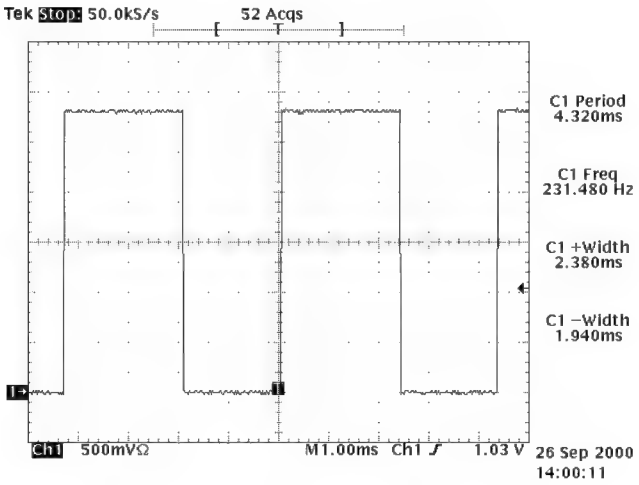


Figure 70. BackPWM signal at pin 31

This signal (Figure 70) is a PWM control for display backlight. The pulse width varies and is constant high for maximum intensity.

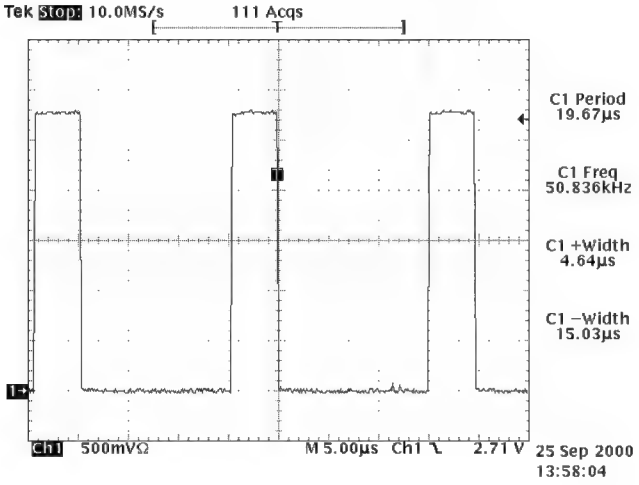


Figure 71. LCDPWM signal at pin 10.

This signal (Figure 71) is a PWM control for display contrast. The pulse width may vary significantly.

Table 3: List of display signals

Table 3. List of display signals

Display Signal	JC4 pin no.	Display Signal	JC4 pin no.
LCDDa0	5	LCDDa10	39
LCDDa1	26	LCDDa11	7
LCDDa2	24	DispClk	2
LCDDa3	38	LLClk	40
LCDDa4	20	FSP	4
LCDDa5	36	DISPON	3

Table 3. (continued) List of display signals

Display Signal	JC4 pin no.	Display Signal	JC4 pin no.
LCDDa6	37	LCDM	18
LCDDa7	22	LCD_PWR	6
LCDDa8	19	LCDPWM	10
LCDDa9	23	BackPWM	31

Table 4. CSP filters and PDA UI signals

Z400	Z401	Z402	Z403	Z404
DispClk	LCDDa11	LCDM	LCDDa1	BackPWM
LCDDa5	LCDPWM	LCDDa8	LCDDa2	
DISPON		LCDDa4	LCDDa9	
LCDDa6		LCDDa7		
FSP				
LCDDa3				
LCDDa0				
LCDDa10				
LCD_PWR				
LLClk				

2.24 BL8 related CMT UI problems

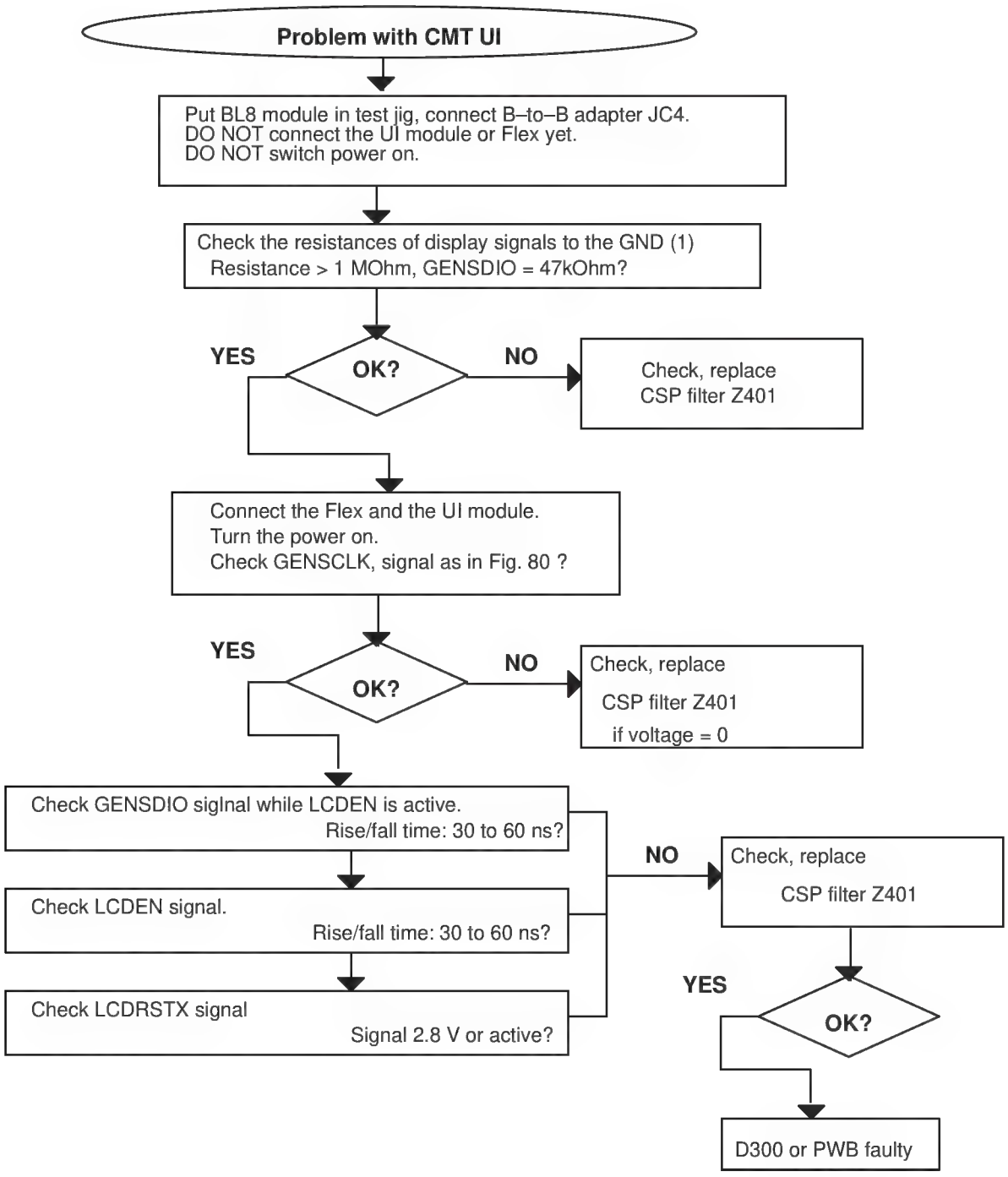


Figure 72.

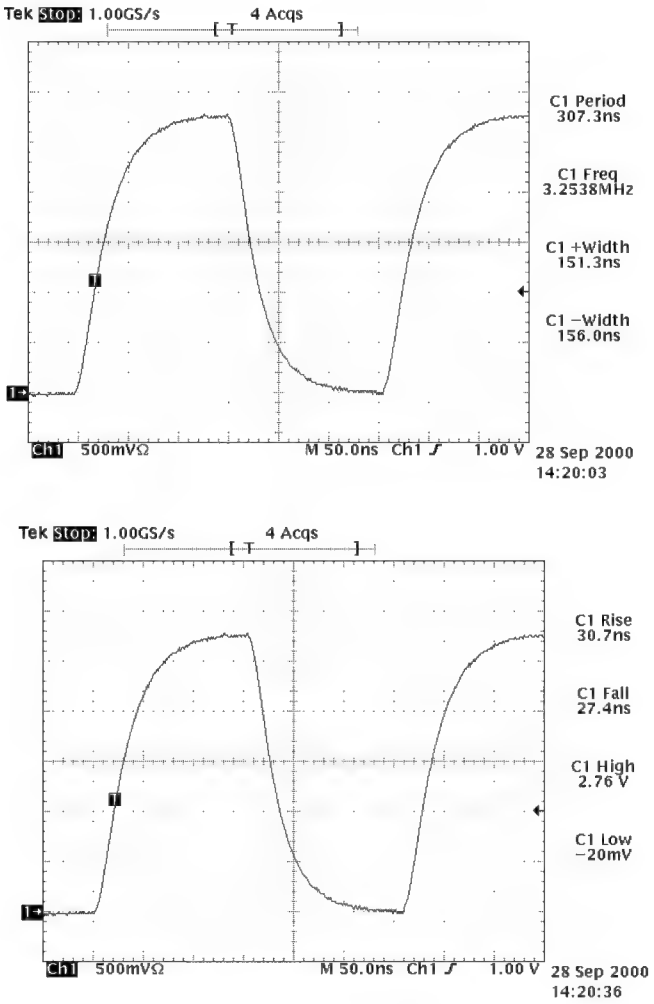


Figure 73. GENSCLK signal.

GENSCLK signal (Figure 73). It should look like this when LCDEN signal is active. There is also a 2.16MHz clock signal, but it is targeted for CCONT.

Table 5. Signals and pins

Signal	Pin no.
LCDEN	12
GENSDIO	9
GENSCLK	11
LCDRSTX	14

Table above: Signals and corresponding pins.

3 DL2 UI Troubleshooting

3.1 CMT and keypad illumination problems

Each CMT–display and keypad LED has its own driver. If there is problems with one or more

– Keypad–LED: check resistors R203–R208, transistors V213, V203, V204 and the LEDs.

– CMT–LED: check resistors R200–R202, transistor V206 and the LEDs.

If the illumination does not work at all, measure voltages VB and KBLIGHTS. VB should be the same as VBATT and KBLIGHTS approximately 2.5V when the LEDs are supposed to be on. If these voltages are not correct, problem is in hinge flex, connector X001 or on BL8 (see 2.23 in this document).

3.2 CMT LCD Troubleshooting

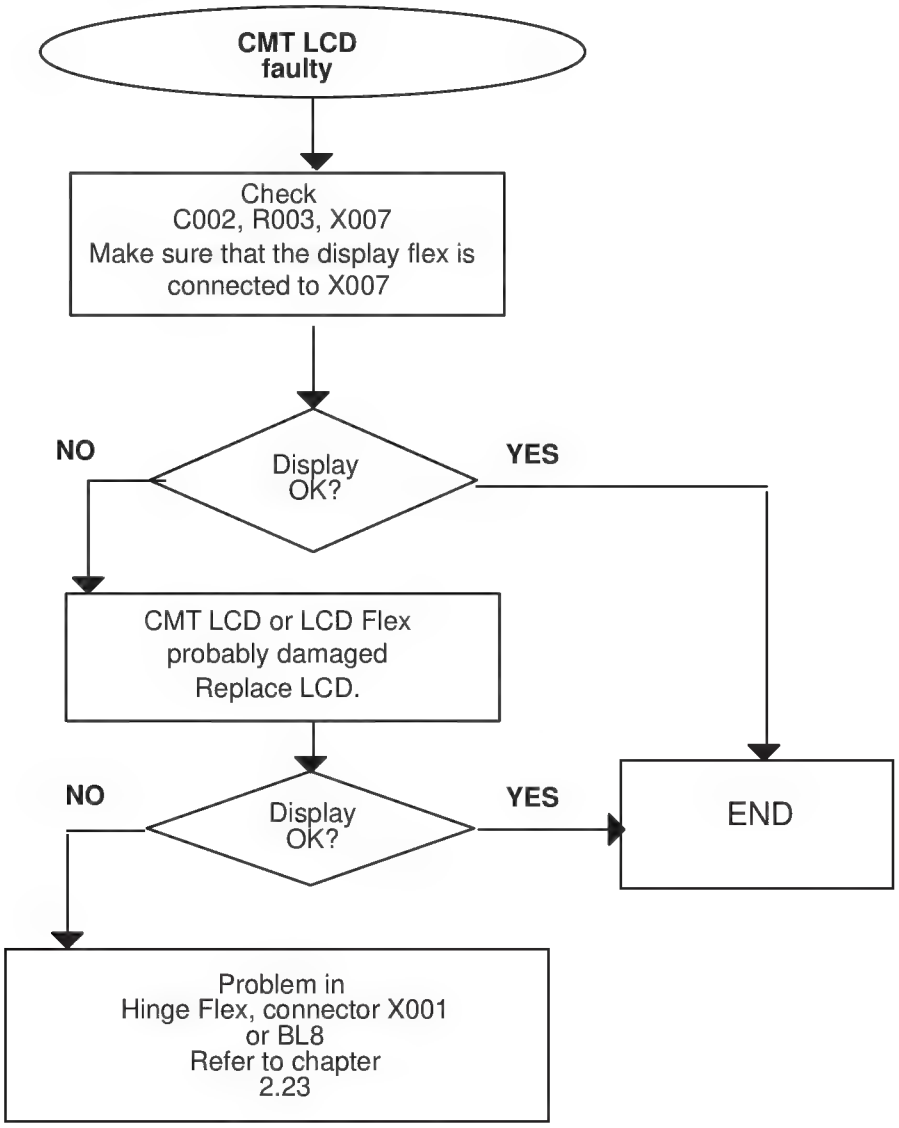

CMT LCD faulty
Check C002, R003, X007 Make sure that the display flex is connected to X007
Display OK?
NO
YES
CMT LCD or LCD Flex probably damaged Replace LCD.
Display OK?
NO
YES
END
Problem in Hinge Flex, connector X001 or BL8 Refer to chapter 2.23

Figure 74.

3.3 No picture on PDA LCD or picture is faulty

To start with, check that the flex connector (X001) from BL8 to UL2 is connected properly and that soldering joints are ok.

Check also connectors X002 and X003. Check that PDA display is not mechanically damaged, i.e. pixels missing.

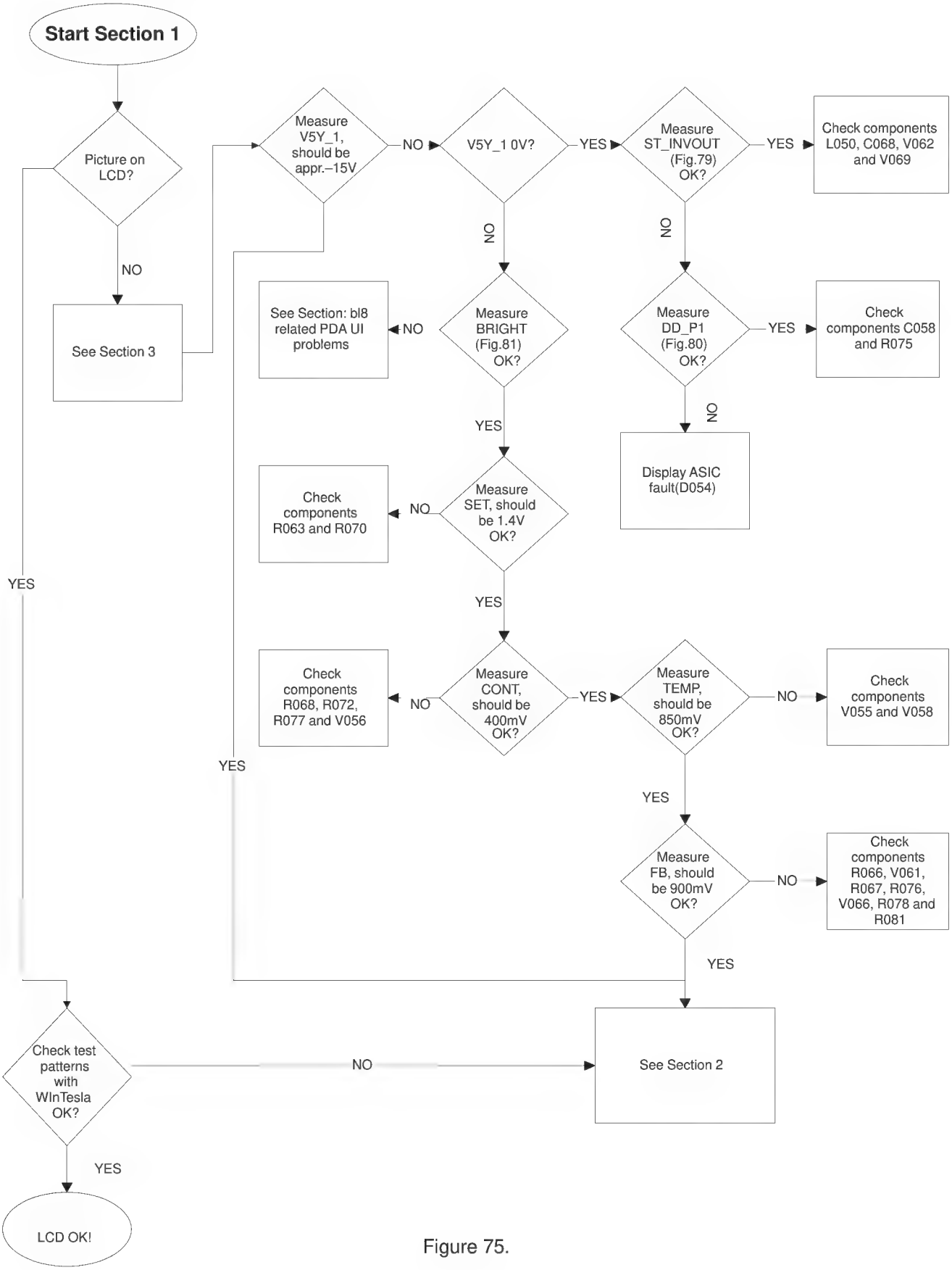

Start Section 1
Picture on LCD?
NO
See Section 3
YES
Measure V5Y_1, should be appr.–15V
NO
V5Y_1 0V?
YES
Measure ST_INVOUT (Fig.79) OK?
YES
Check components L050, C068, V062 and V069
NO
Measure DD_P1 (Fig.80) OK?
YES
Check components C058 and R075
NO
Display ASIC fault(D054)
NO
Measure BRIGHT (Fig.81) OK?
NO
See Section: bl8 related PDA UI problems
YES
Measure SET, should be 1.4V OK?
NO
Check components R063 and R070
YES
Measure CONT, should be 400mV OK?
NO
Check components R068, R072, R077 and V056
YES
Measure TEMP, should be 850mV OK?
NO
Check components V055 and V058
YES
Measure FB, should be 900mV OK?
NO
Check components R066, V061, R067, R076, V066, R078 and R081
YES
Check test patterns with WInTesla OK?
NO
See Section 2
YES
LCD OK!

Figure 75.

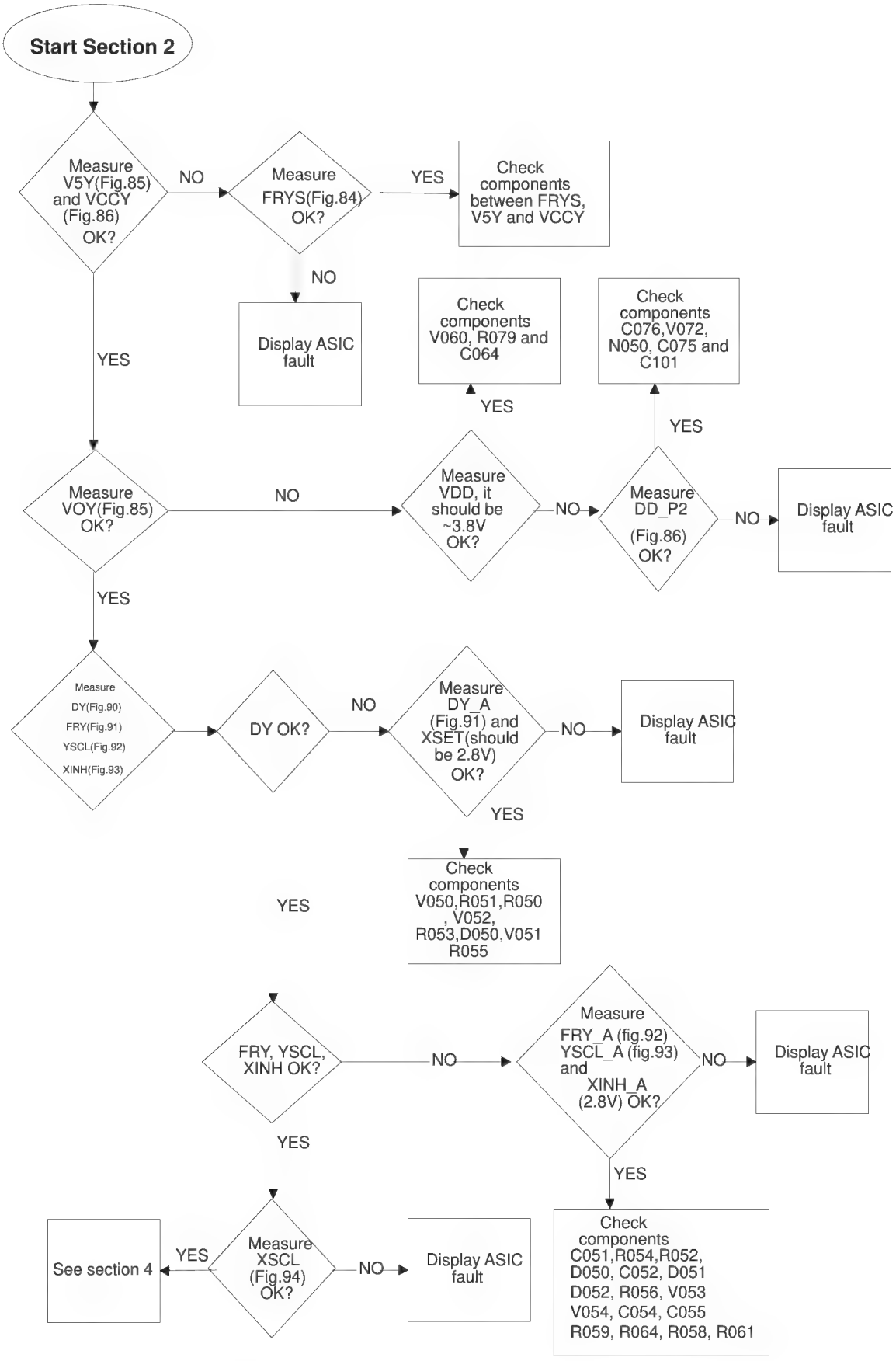

Start Section 2
Measure V5Y(Fig.85) and VCCY (Fig.86) OK?
NO
Measure FRYS(Fig.84) OK?
YES
Check components between FRYS, V5Y and VCCY
NO
Display ASIC fault
YES
Measure VOY(Fig.85) OK?
NO
Measure VDD, it should be ~3.8V OK?
YES
Check components V060, R079 and C064
NO
Measure DD_P2 (Fig.86) OK?
YES
Check components C076,V072, N050, C075 and C101
NO
Display ASIC fault
YES
Measure DY(Fig.90) FRY(Fig.91) YSCL(Fig.92) XINH(Fig.93)
DY OK?
NO
Measure DY_A (Fig.91) and XSET(should be 2.8V) OK?
NO
Display ASIC fault
YES
Check components V050,R051,R050 , V052, R053,D050,V051 R055
YES
FRY, YSCL, XINH OK?
NO
Measure FRY_A (fig.92) YSCL_A (fig.93) and XINH_A (2.8V) OK?
NO
Display ASIC fault
YES
Check components C051,R054,R052, D050, C052, D051 D052, R056, V053 V054, C054, C055 R059, R064, R058, R061
YES
Measure XSCL (Fig.94) OK?
NO
Display ASIC fault
YES
See section 4

Figure 76.

NOTE!! See section 2.23. There are all the relevant pictures of the signals mentioned below. Measure these signals from UL2 side. This is to make sure that the problem is not in BL8 side.

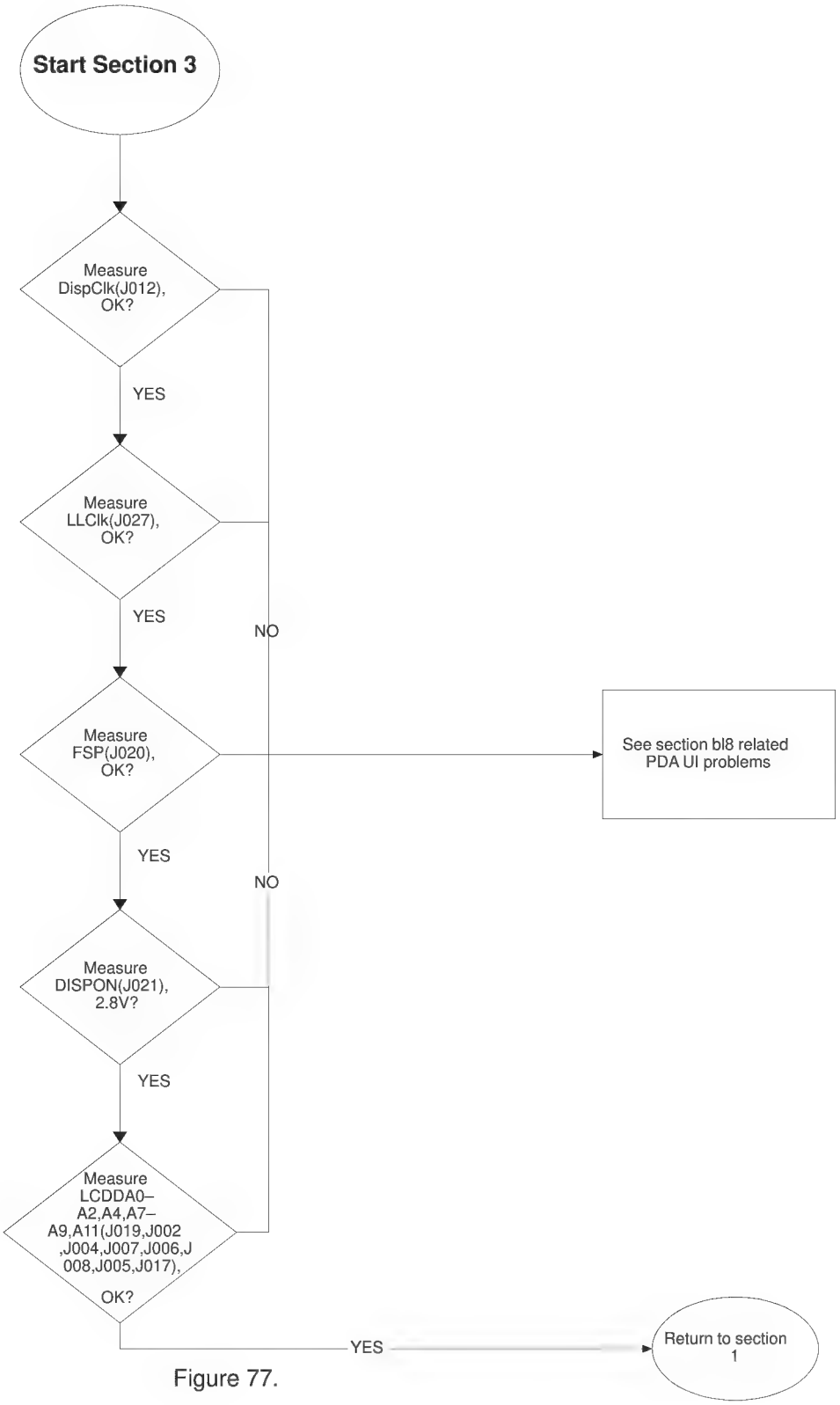


Figure 77.

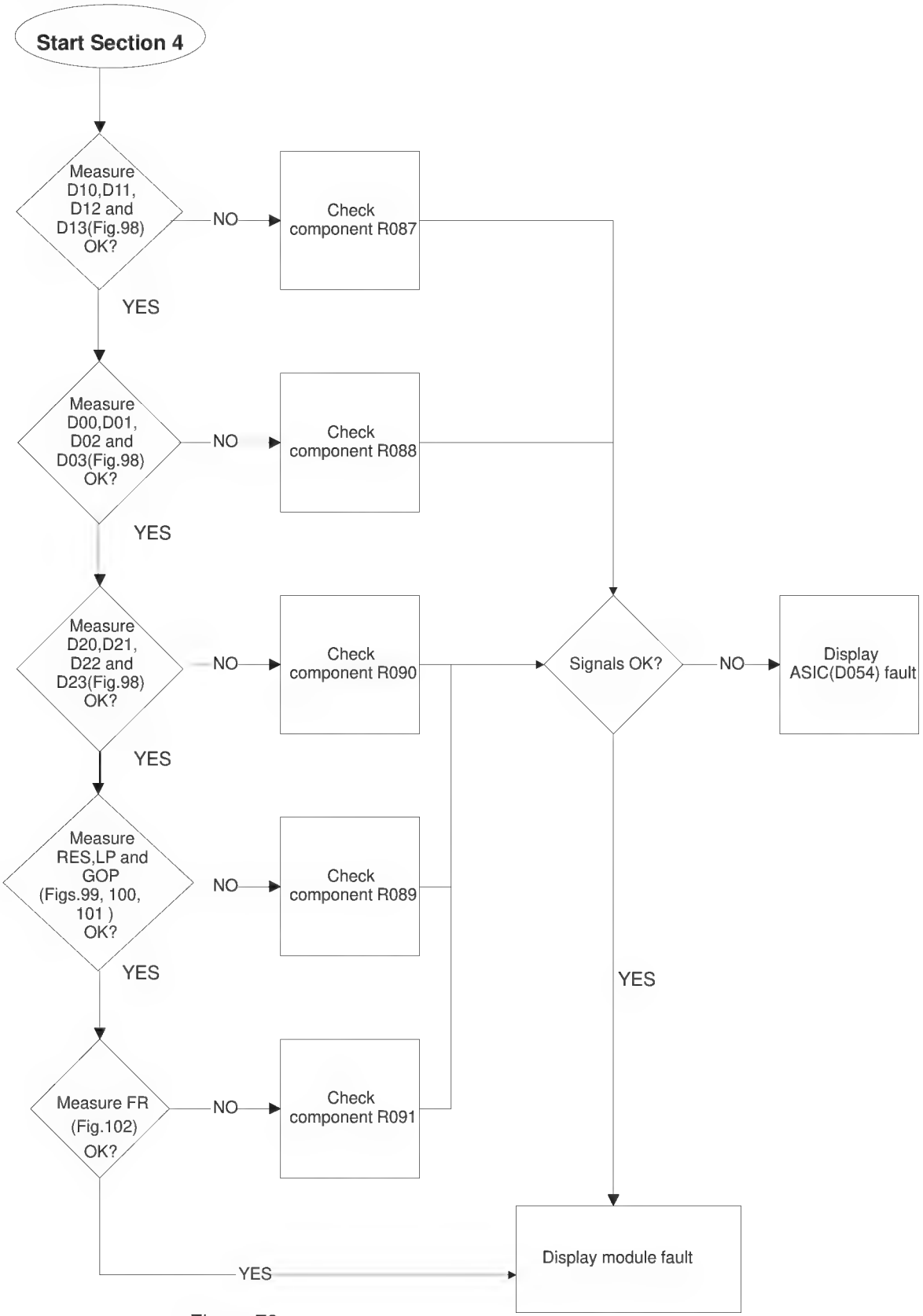

Start Section 4
Measure D10,D11, D12 and D13(Fig.98) OK?
NO
Check component R087
YES
Measure D00,D01, D02 and D03(Fig.98) OK?
NO
Check component R088
YES
Measure D20,D21, D22 and D23(Fig.98) OK?
NO
Check component R090
YES
Measure RES,LP and GOP (Figs.99, 100, 101) OK?
NO
Check component R089
YES
Measure FR (Fig.102) OK?
NO
Check component R091
YES
Signals OK?
NO
Display ASIC(D054) fault
YES
Display module fault

Figure 78.

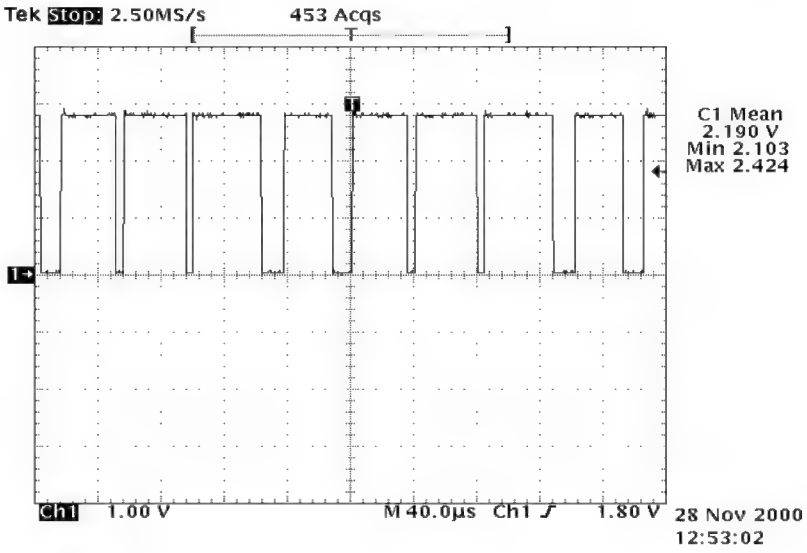


Figure 79. ST_INVOUT signal

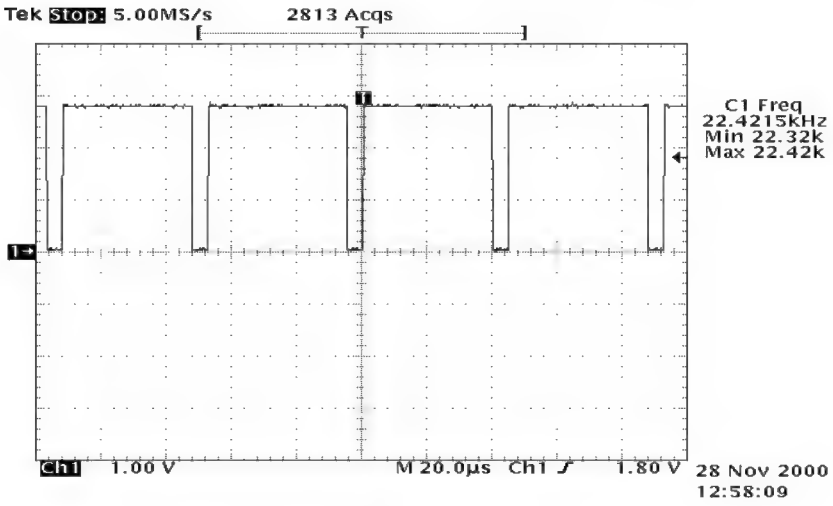


Figure 80. DD_P1 signal

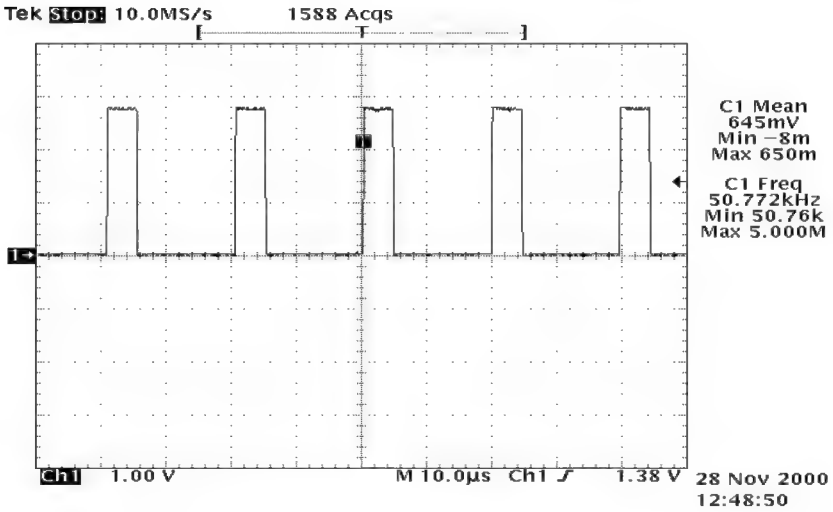


Figure 81. BRIGHT signal

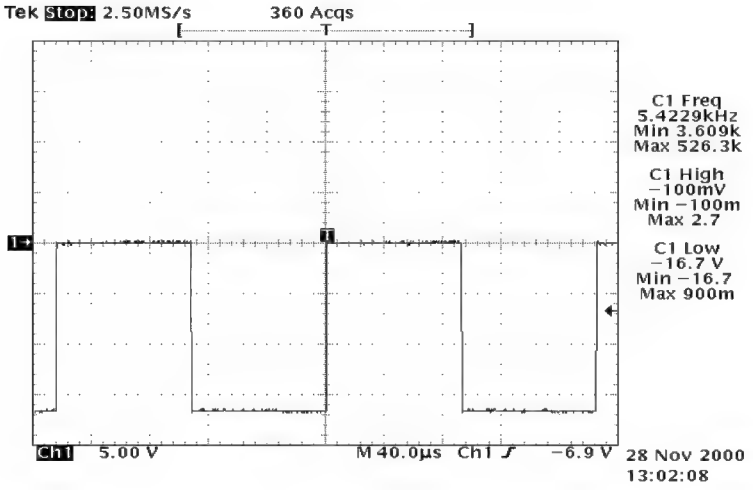


Figure 82. V5Y signal

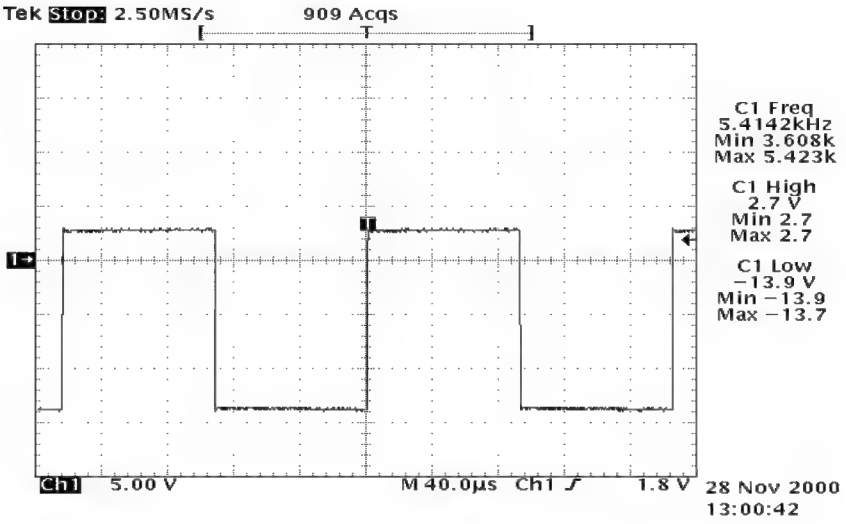


Figure 83. VCCY signal

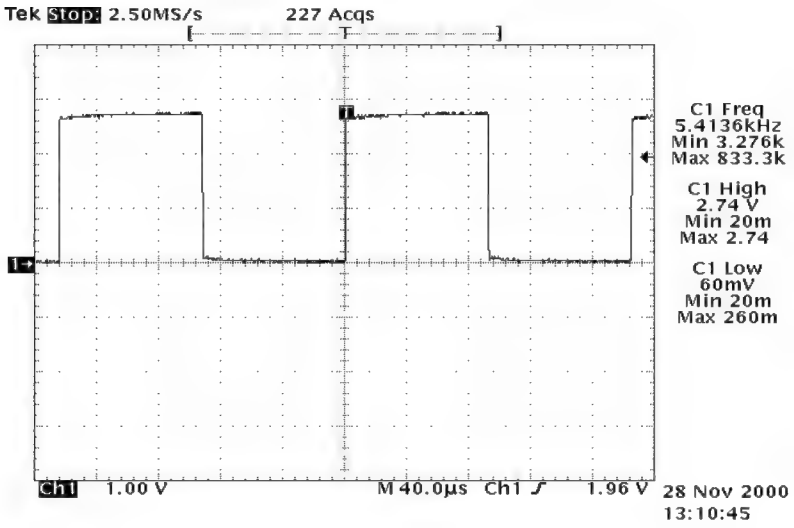


Figure 84. FRYS signal

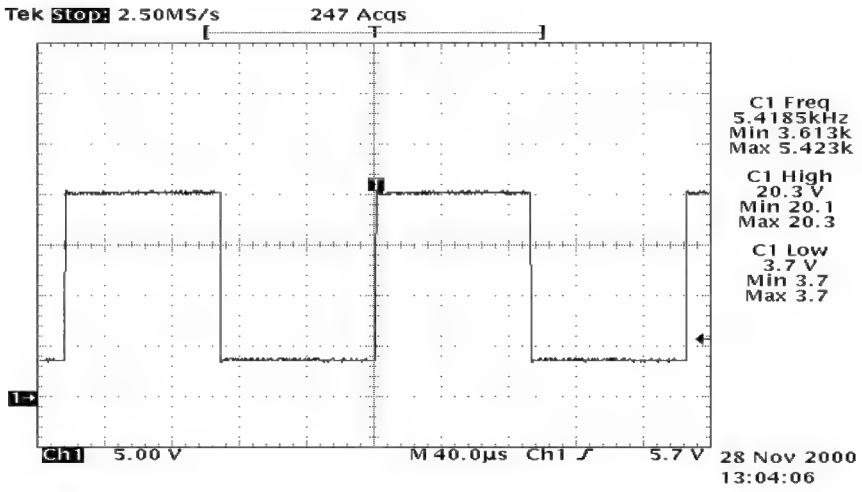


Figure 85. VOY signal

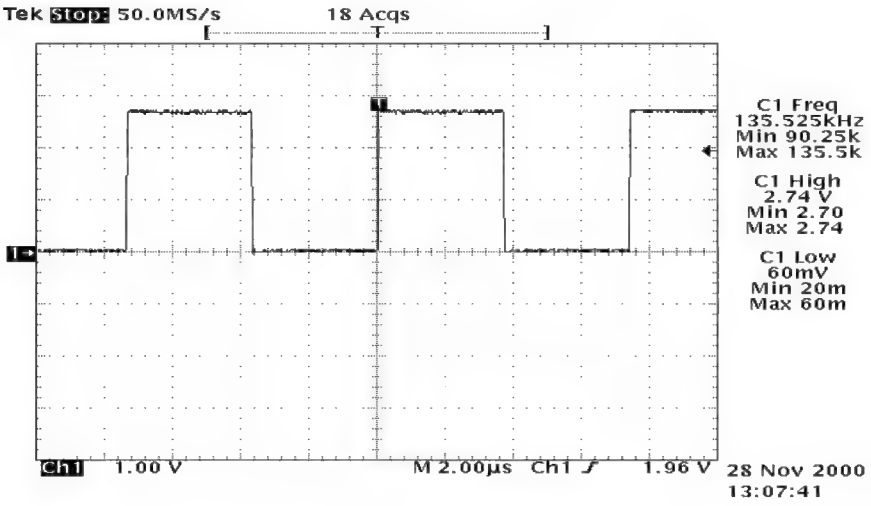


Figure 86. DD_P2 signal

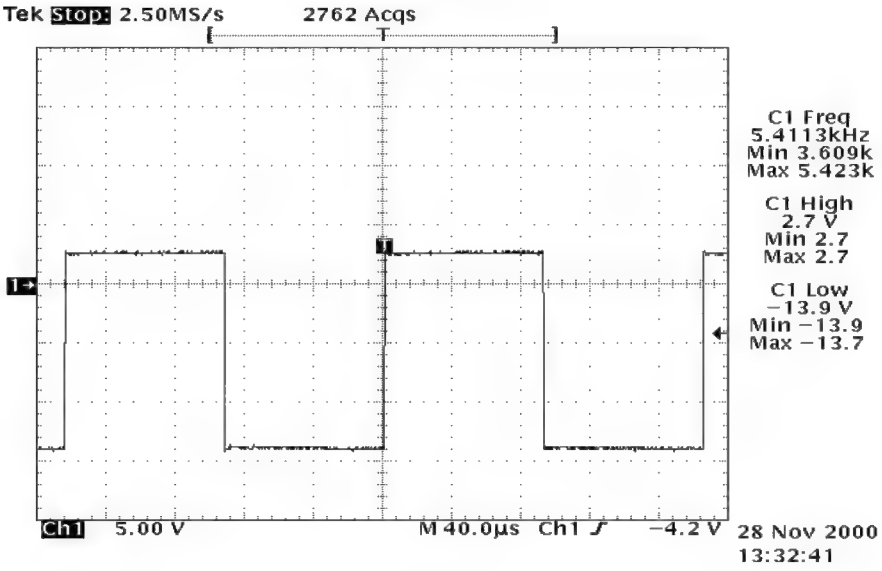


Figure 87. DY signal

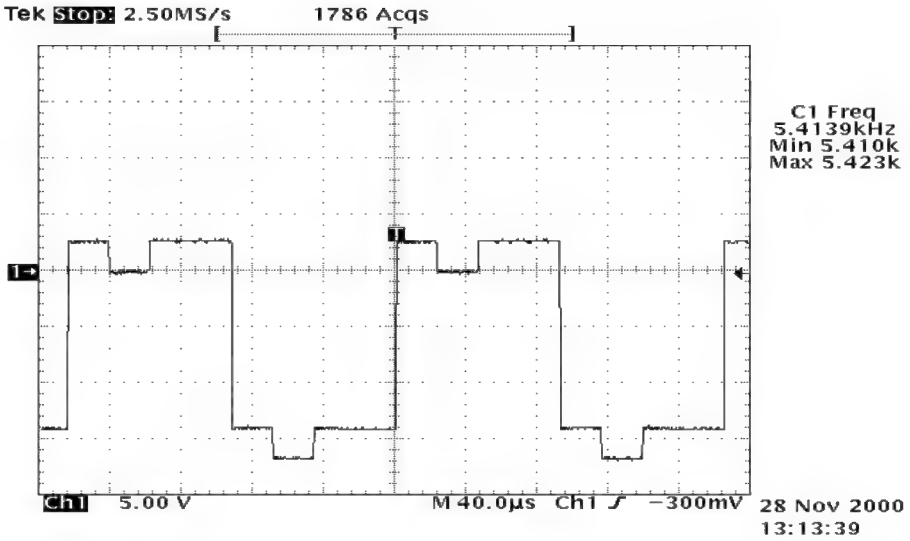


Figure 88. FRY signal

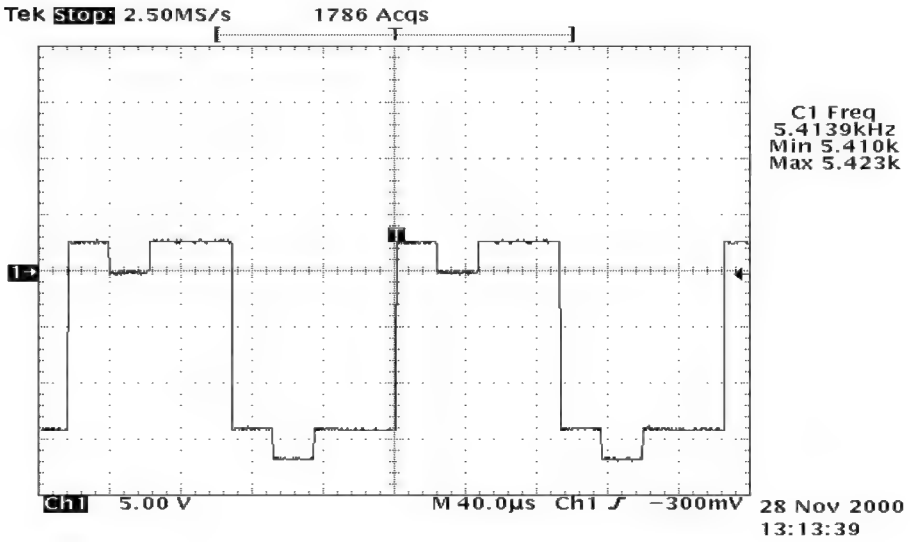


Figure 89. YSCL signal

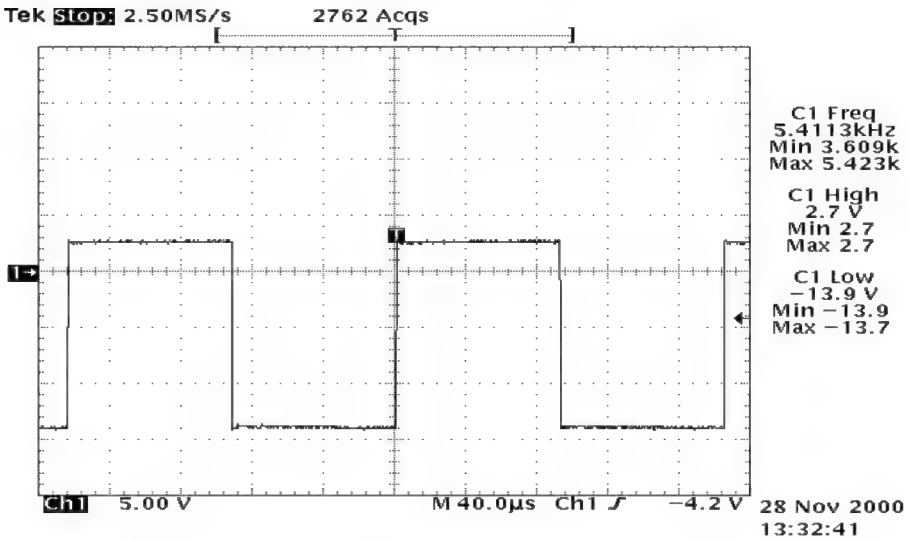


Figure 90. XINH signal

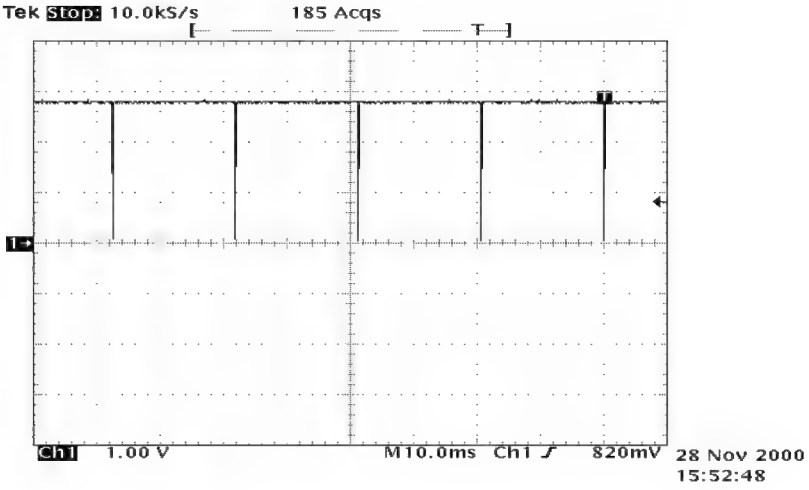


Figure 91. DY_A signal

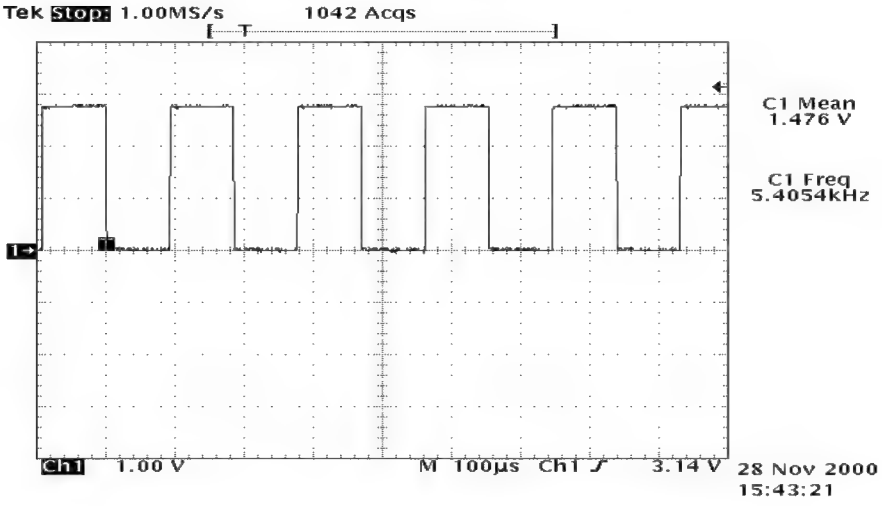


Figure 92. FRY_A

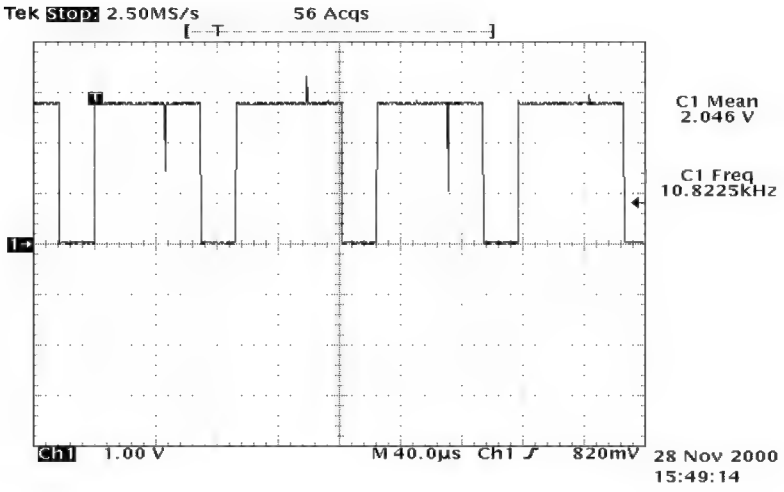


Figure 93. YSCL_A signal

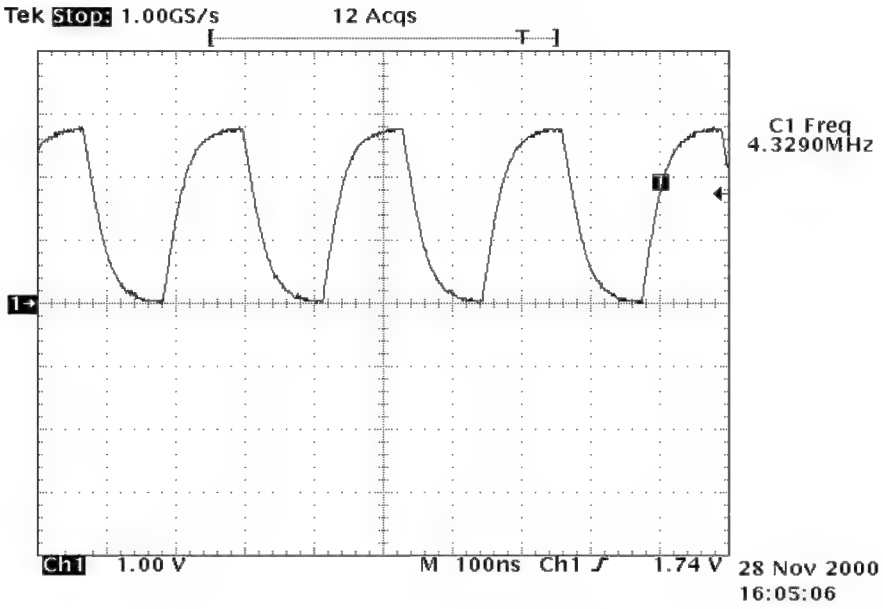


Figure 94. XSCL signal

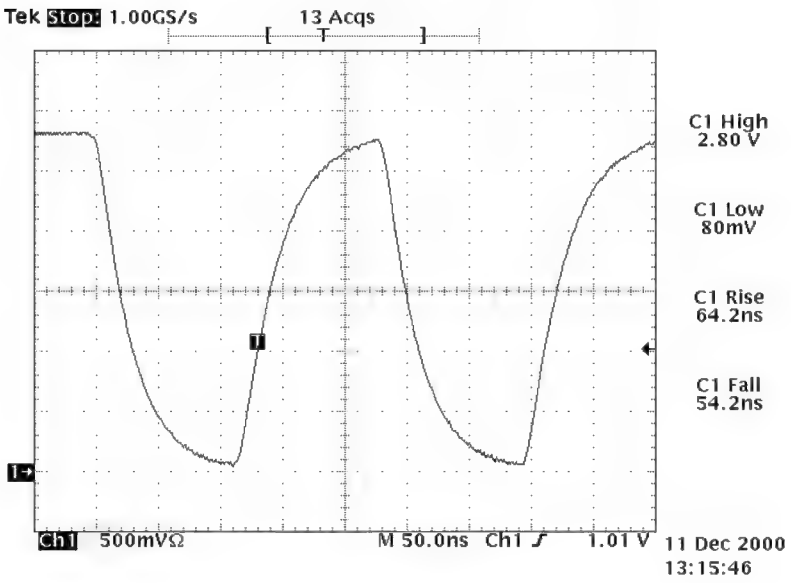


Figure 95. Data signal

(Note!! There should be constant activity in the datalines and signals should look something like this.)

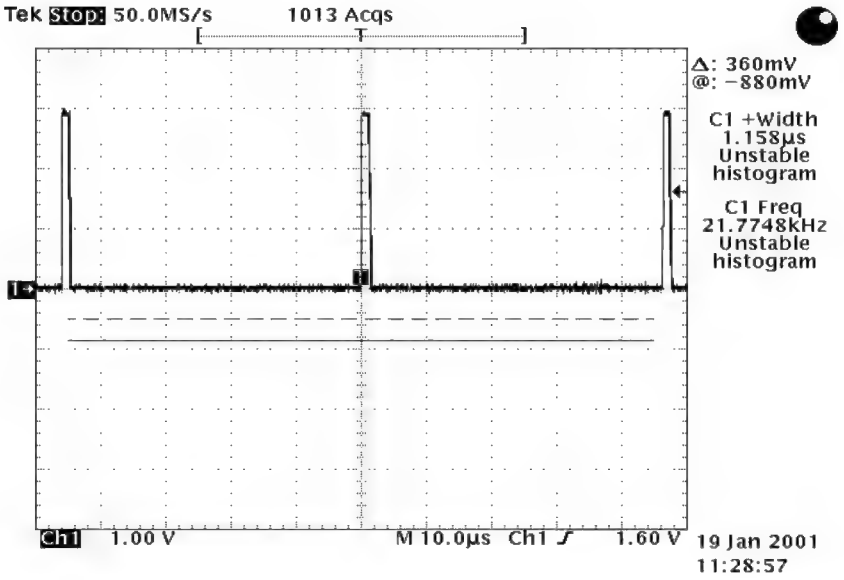


Figure 96. RES signal

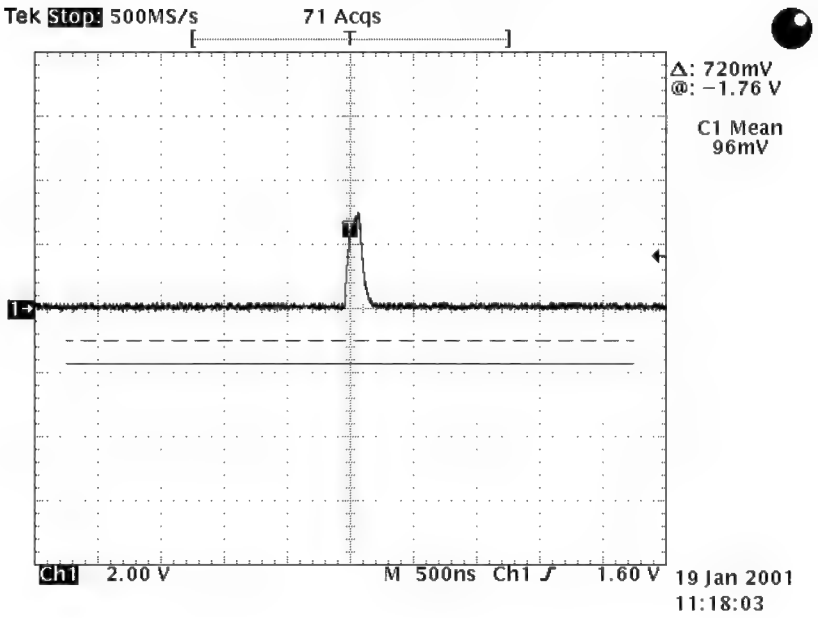


Figure 97. GOP signal

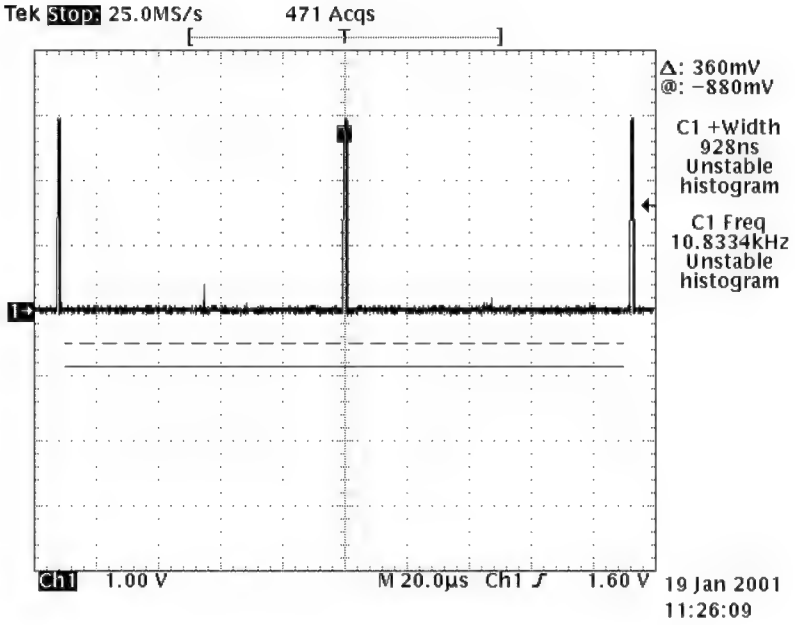


Figure 98. LP signal

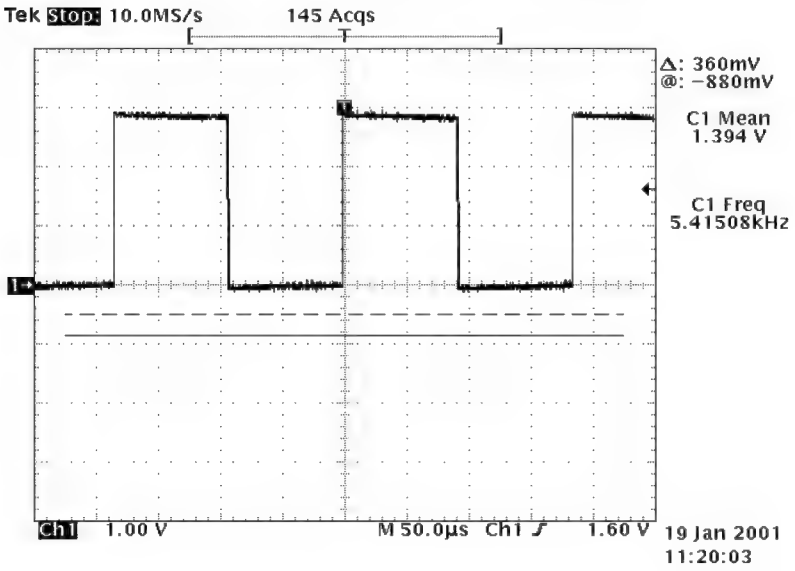


Figure 99. FR signal

3.4 Backlight troubleshooting

NOTE: when making measurements, make sure that BACK_PWM is 100%

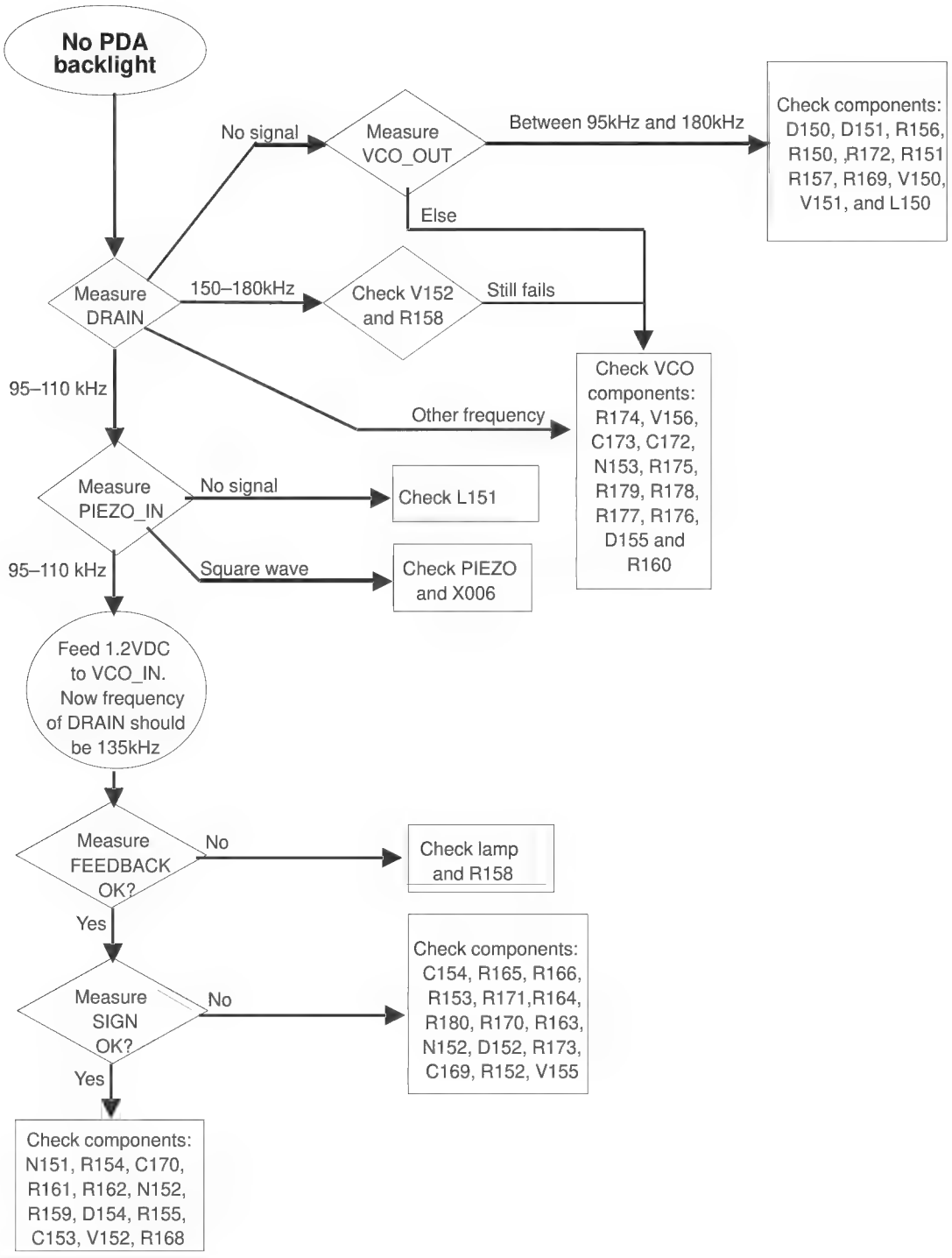

No PDA backlight
Measure DRAIN
No signal
Measure VCO_OUT
Between 95kHz and 180kHz
Check components: D150, D151, R156, R150, R172, R151 R157, R169, V150, V151, and L150
Else
150–180kHz
Check V152 and R158
Still fails
Check VCO components: R174, V156, C173, C172, N153, R175, R179, R178, R177, R176, D155 and R160
95–110 kHz
Other frequency
Measure PIEZO_IN
No signal
Check L151
95–110 kHz
Square wave
Check PIEZO and X006
Feed 1.2VDC to VCO_IN. Now frequency of DRAIN should be 135kHz
Measure FEEDBACK OK?
No
Check lamp and R158
Yes
Measure SIGN OK?
No
Check components: C154, R165, R166, R153, R171,R164, R180, R170, R163, N152, D152, R173, C169, R152, V155
Yes
Check components: N151, R154, C170, R161, R162, N152, R159, D154, R155, C153, V152, R168

Figure 100.

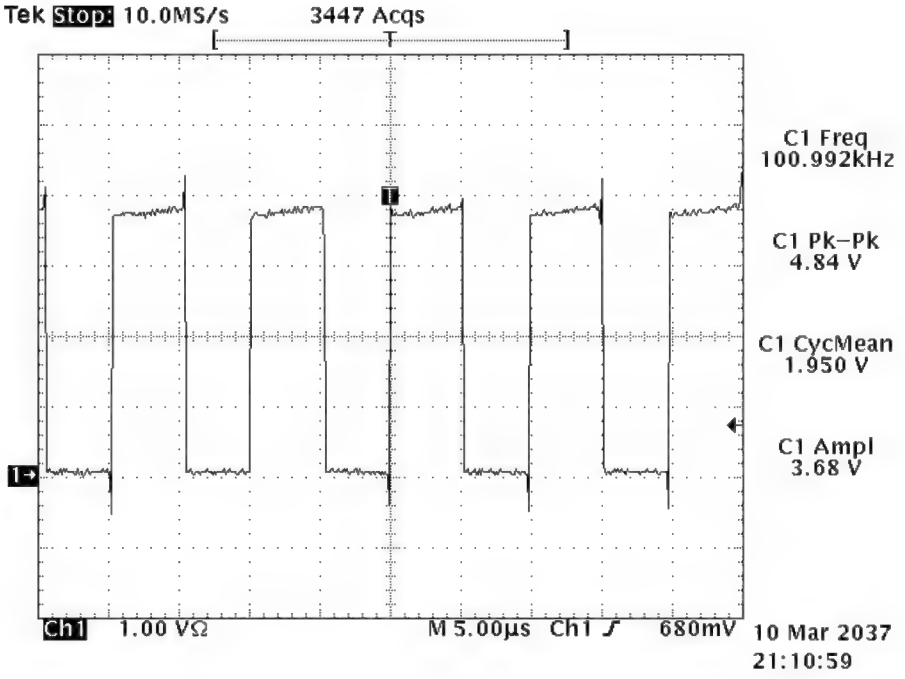


Figure 101. DRAIN (no light)

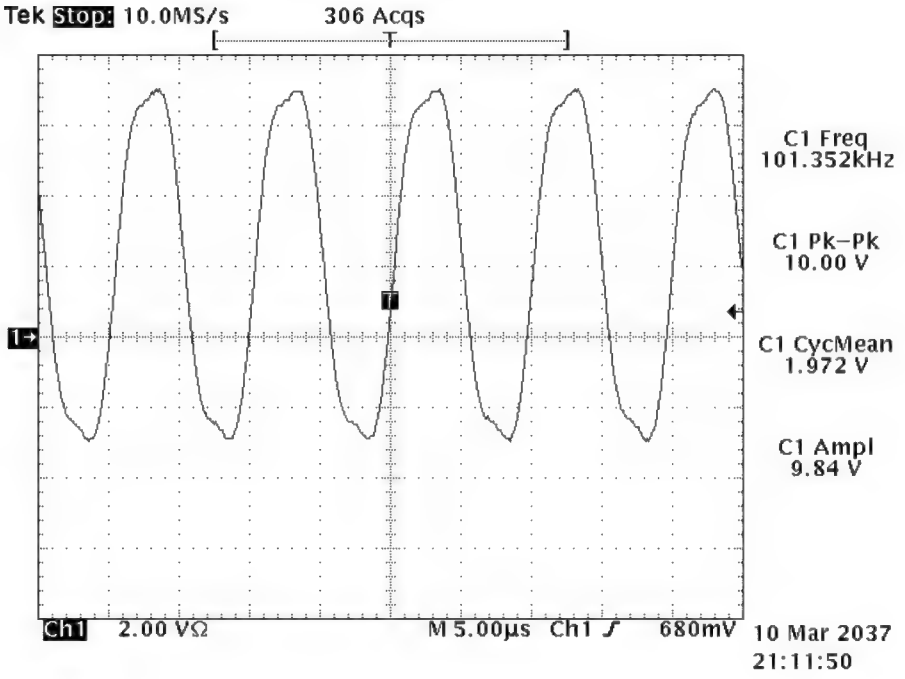


Figure 102. PIEZO_IN (no light)

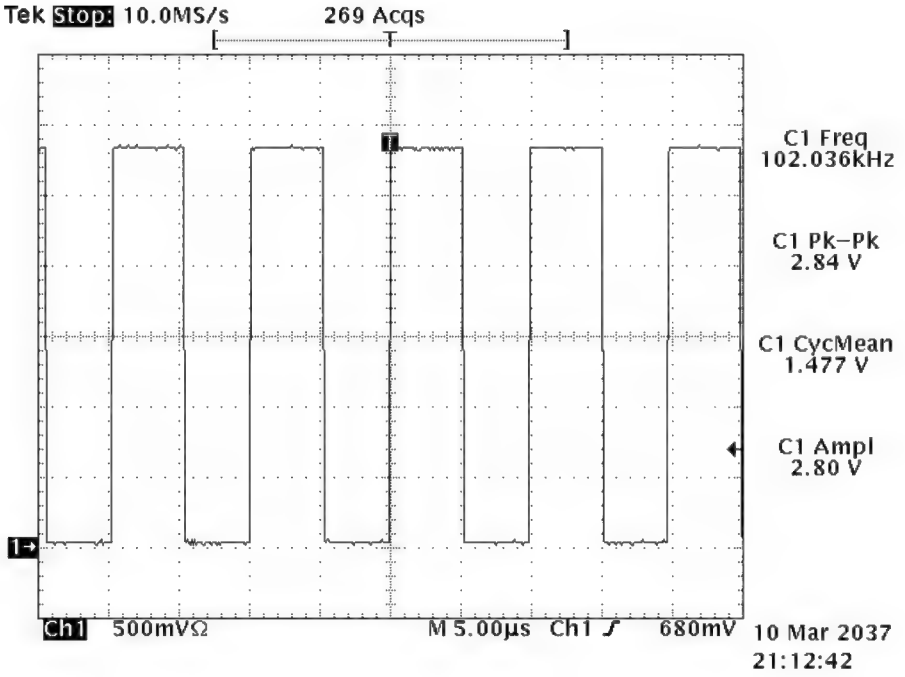


Figure 103. VCO_OUT (no light)

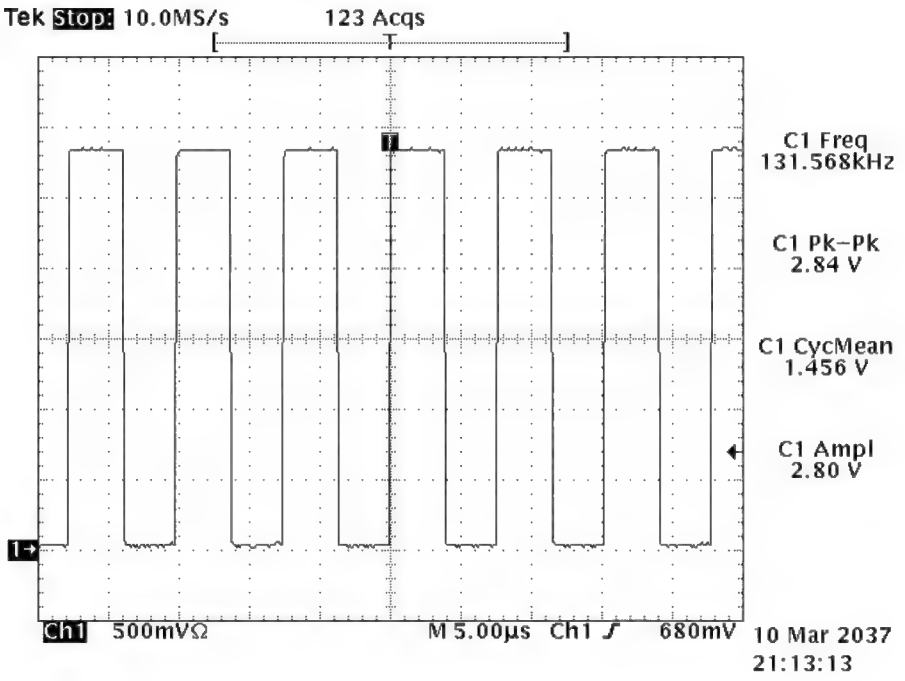


Figure 104. VCO_OUT (light on)

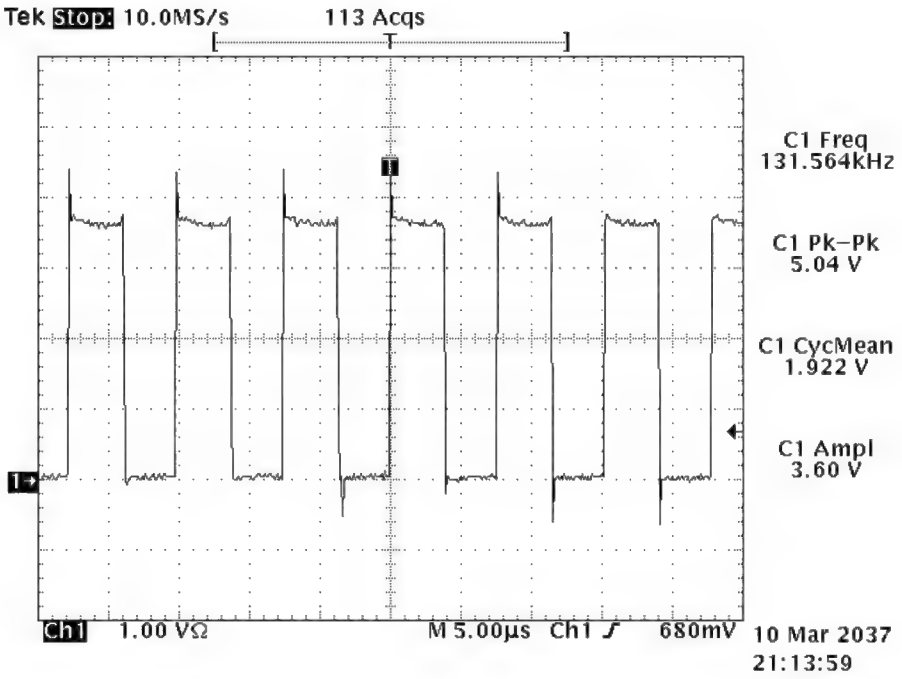


Figure 105. DRAIN (light on)

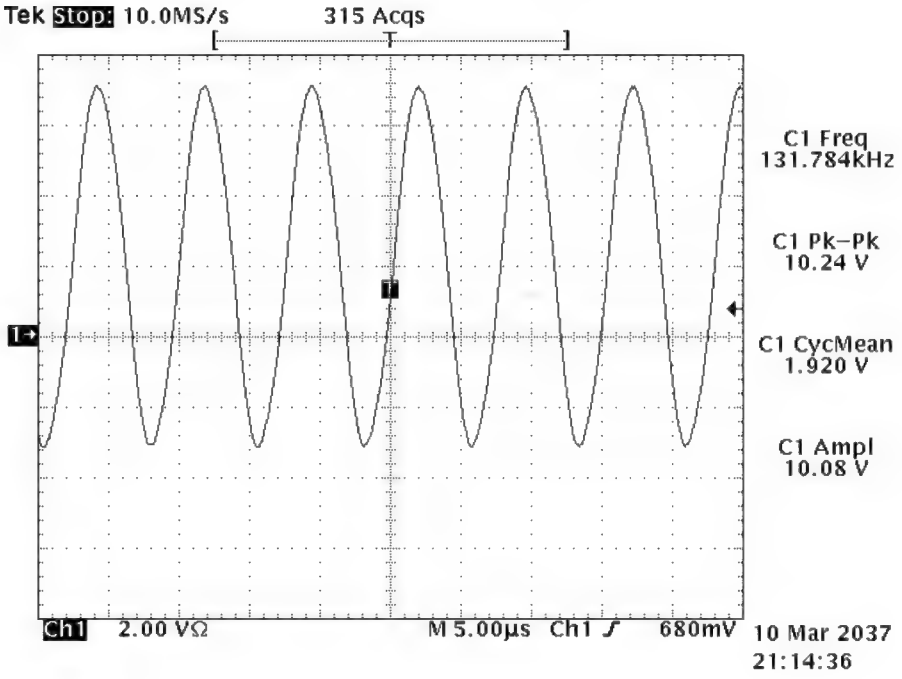


Figure 106. PIEZO_IN (light on)

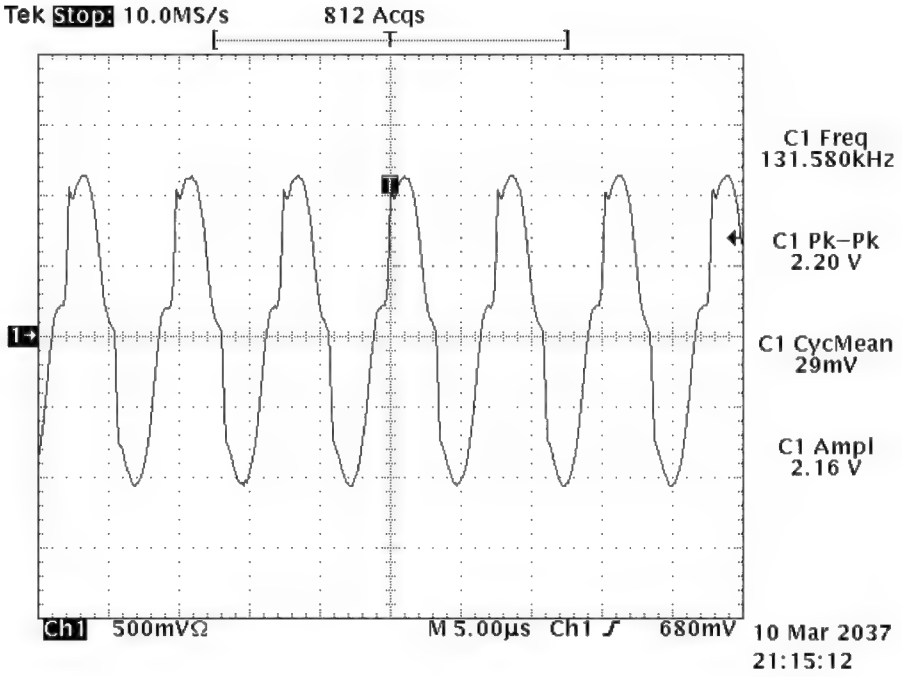


Figure 107. FEEDBACK (light on)

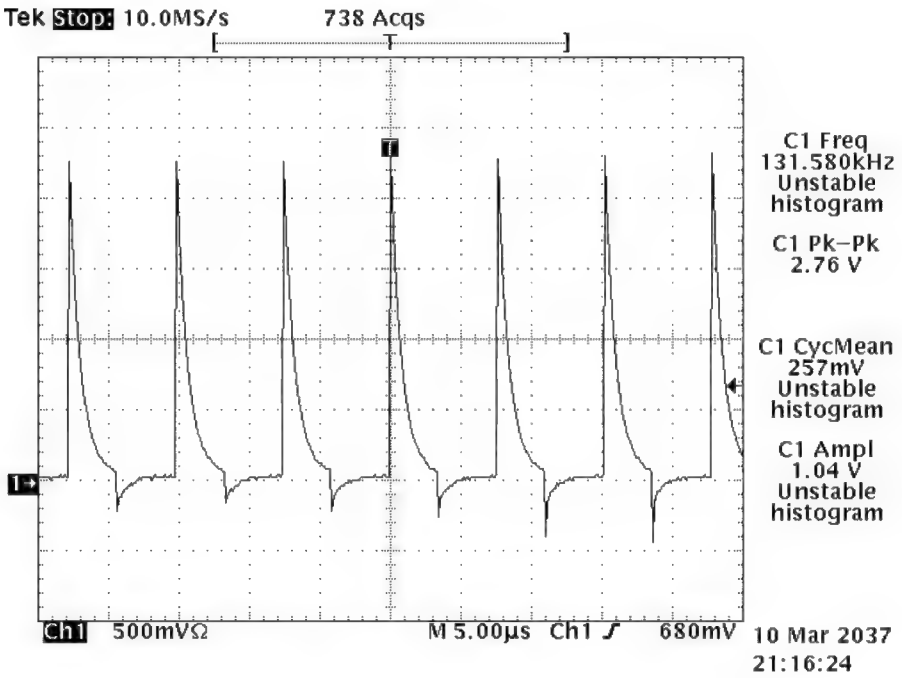


Figure 108. SIGN (light on)

3.5 DL2 related keyboard problems

1. Check the 50–way connector solderings and general condition
2. Check PDA softkey switches S250, S251, S260, S261
3. Check keyboard line capacitors C250–C263 (14 pieces) for shorts and breakages
4. Check the key pads for short circuits or dirt. Measure the resistance of each row against all columns and all rows and columns against ground. (Disconnect the 50–way connector first). Result should be > 1Mohm for all combinations.

4 UL 8 FLEX related

4.1 Audio troubleshooting

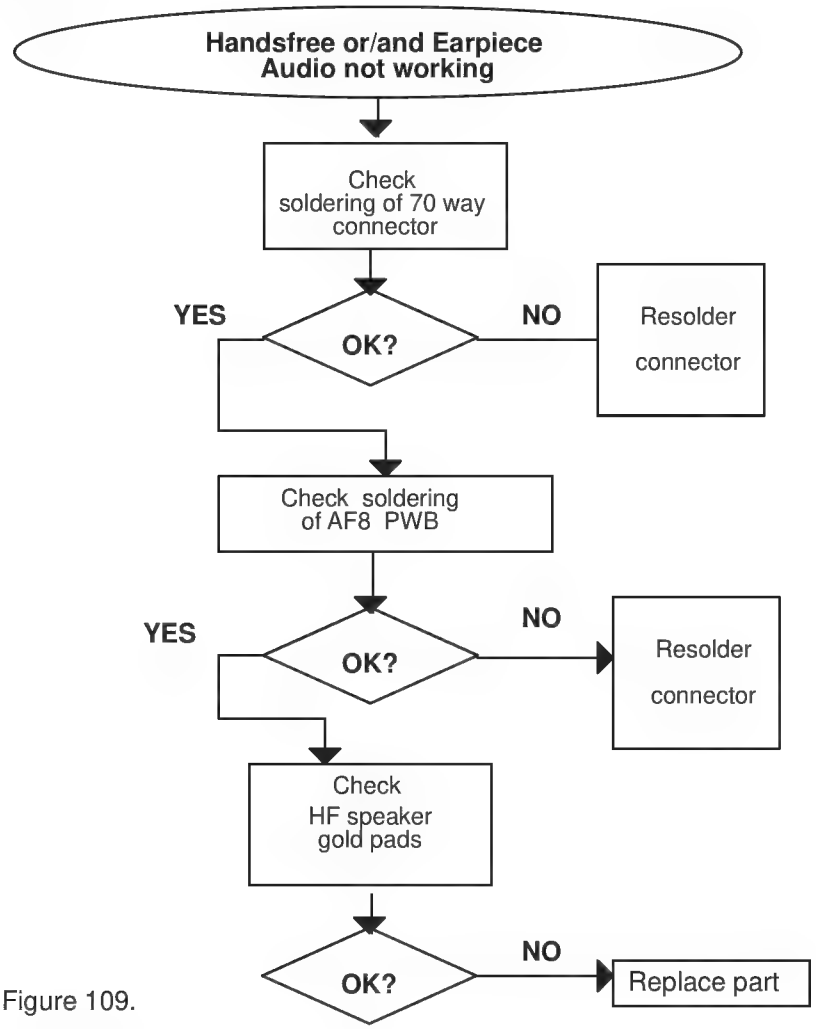


Figure 109.

AF 8 illustrated below (Figure 110).

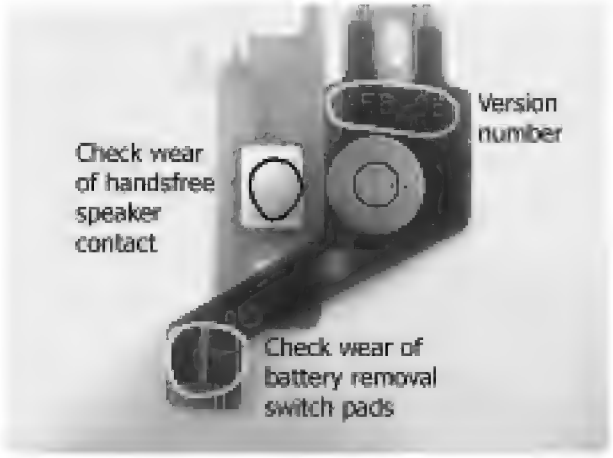


Figure 110. AF8

4.2 Display problem

PDA or CMT displays are missing lines or columns, or are not synchronised

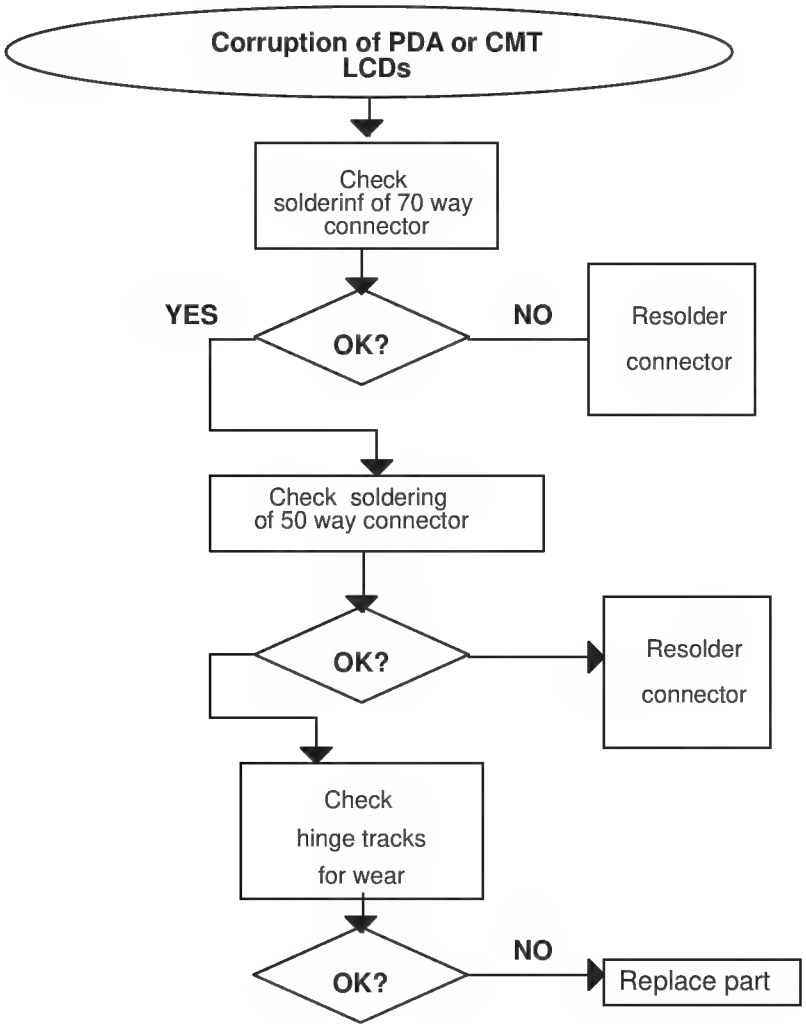


Figure 111.

4.3 Battery Removal Switch problem

If the battery removal switch is not functional, check AF 8 for wear, illustrated below. (Check that the RAE-3 software supports the battery removal switch feature.)

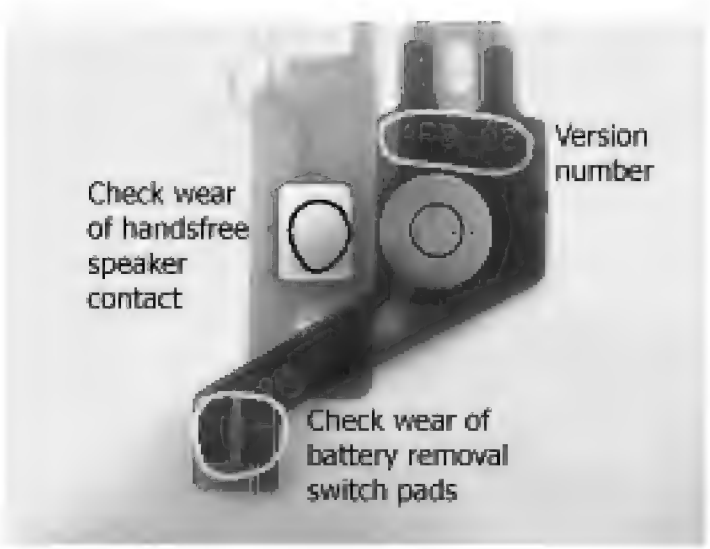


Figure 112. AF8

4.4 UL8 related keyboard problems

1. Check the 70–way and 50–way connector solderings and general condition. Re–solder if fault found.
2. Check the keypad surface for short circuits or dirt.
3. Replace the flex.

5 RF related

Introduction to troubleshooting

Measurements must be done using Spectrum Analyzer with high–frequency high–impedance passive probe (LO–/reference frequencies and RF–power levels) and Oscilloscope with a 10:1 probe (DC–voltages and low frequency signals).

The RF–section is build around one ASICS Hagar (N505). For easier troubleshooting, this RF troubleshooting document is divided into sections.

Before changing Hagar, please check the following things: Supply voltages are OK and serial communication are coming to Hagar.

Please note that the grounding of the PA–module is directly below PA–module so it is difficult to check or change. **Most RF semiconductors are static discharge sensitive!** So ESD protection must be taken during repair (ground straps and ESD soldering irons). Hagar are moisture sensitive so parts must be pre–baked prior to soldering.

Apart from key–components described in this document here are a lot of discrete components (resistors, inductors and capacitors) which troubleshooting is done by checking if soldering of the component is done properly, for factory repairs (checking if it is missing from PWB). Capacitors can be checked for shortening and resistors for value by means of an ohmmeter, but be aware in–circuit measurements should be evaluated carefully.

Please be aware that all measured voltages or **RF levels in this document are rough figures**. Especially RF levels varies due to different measuring equipment or different grounding of the used probe.

5. RF related :

    5.1 EGSM receiver

    5.2 PCN receiver

    5.3 EGSM transmitter

    5.4 PCN transmitter

    5.5 Synthesizer

    5.6 Frequency lists

RF Key Component Placement

Figure 113. Parts placement 1

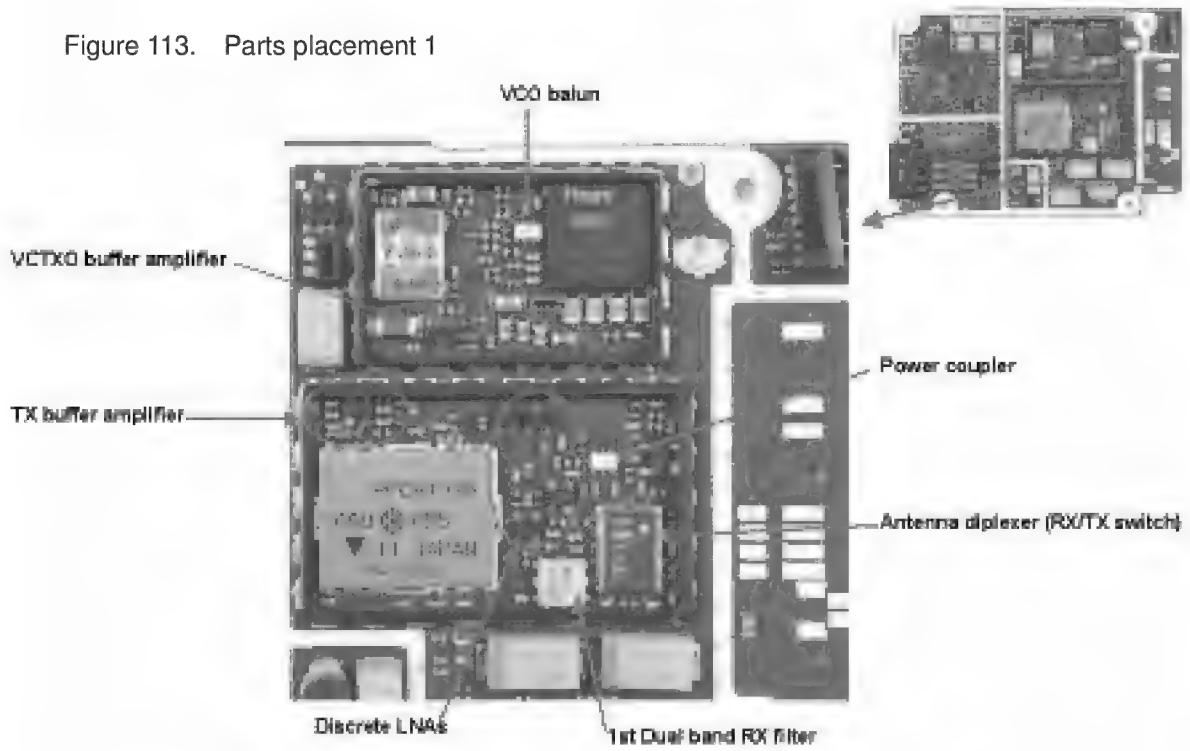
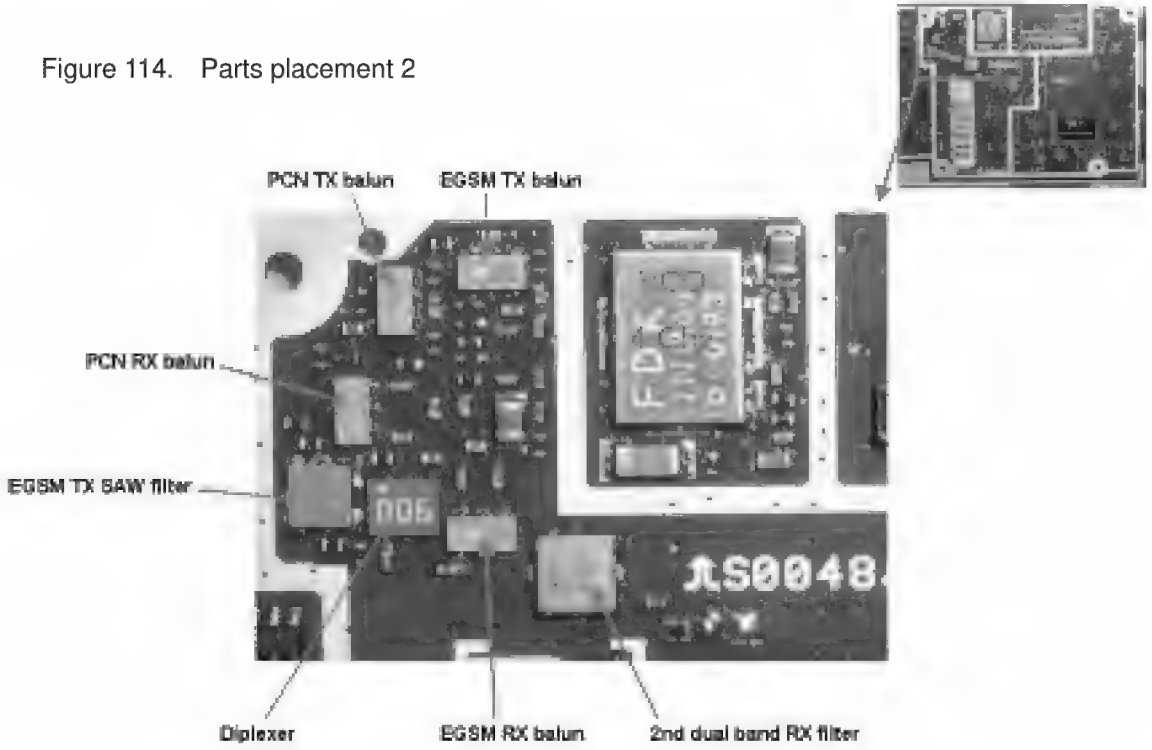


Figure 114. Parts placement 2



5.1 EGSM Receiver

General Instructions for troubleshooting

Select	Product		Alt+p
	.....	Open...	
		RAE–3	
Select:	Product		Alt+p
		Band	b
		EGSM	e
Select:	Testing		Alt+e
		RF Controls	r
		RX Continuous	Alt+r
		Cont. Mode Ch: 60	Alt+o, 60
		AGC Absolute: 8	
		Multislot on	Alt+u, (if on remove checkmark)
		Apply	

The set–up should now look like this (Figure 115):

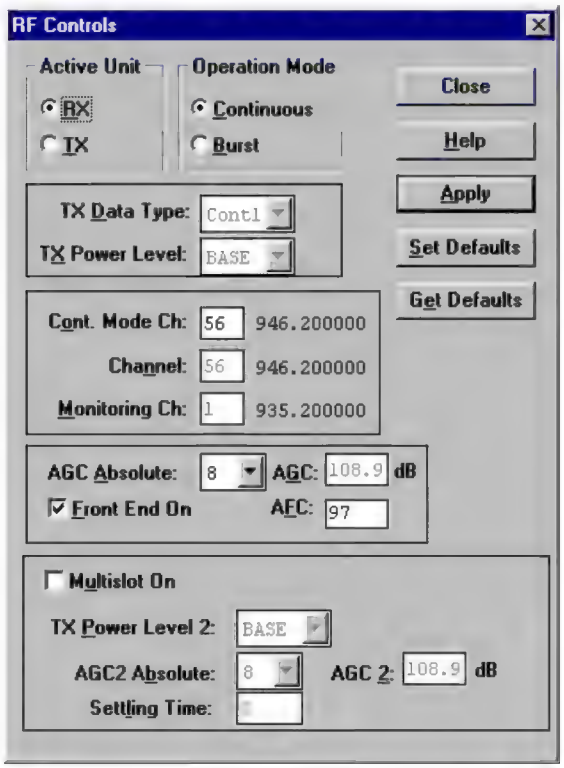


Figure 115.

Apply a 947.06771MHz (channel 60 + 67.710kHz offset) –95 dBm signal to the RF–connector (remember to compensate for cable attenuation).

Measuring with an oscilloscope on “Hagar RXI” or “Hagar RXQ” this picture should be seen from a working EGSM receiver:

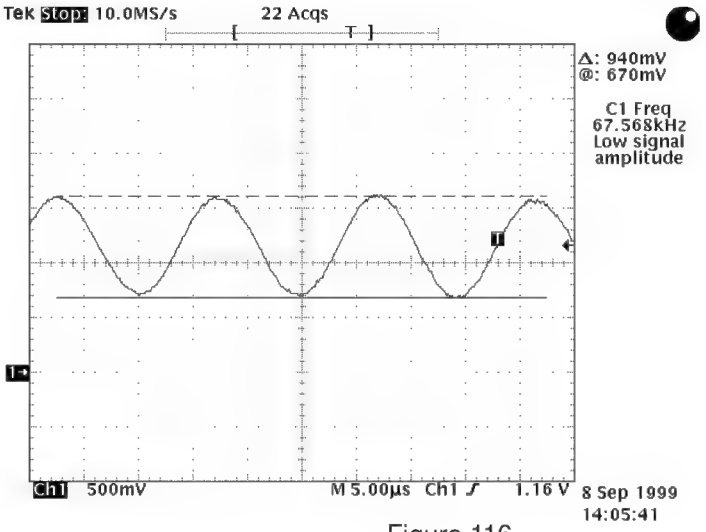


Figure 116.

Signal amplitude	390mV p–p
DC offset	1,1V
Frequency	67kHz

If this picture is not seen, continue to the next section.

5.1.1 Troubleshooting diagram for EGSM Receiver

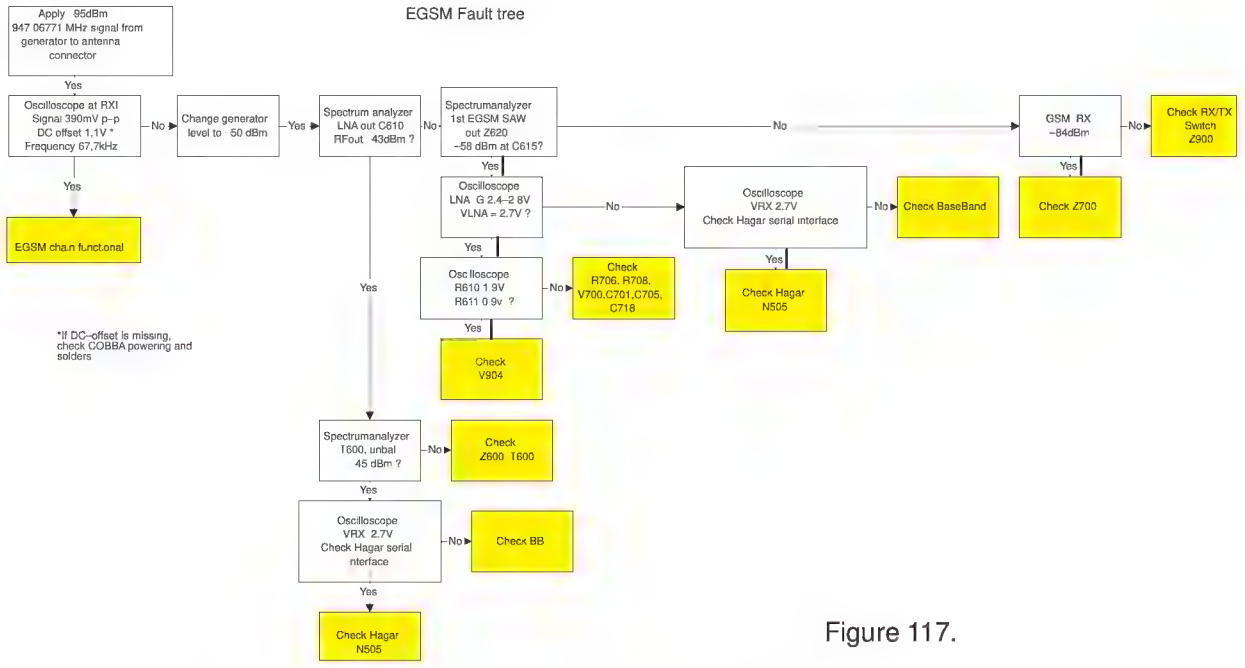


Figure 117.

Note: RF levels measured with HP85024A RF probe.

5.1.2 EGSM Signal Path

For easy error tracing it is important to know the signal path of the EGSM receiver. The components can be grouped into blocks and drawn as shown below (Figure 118) .

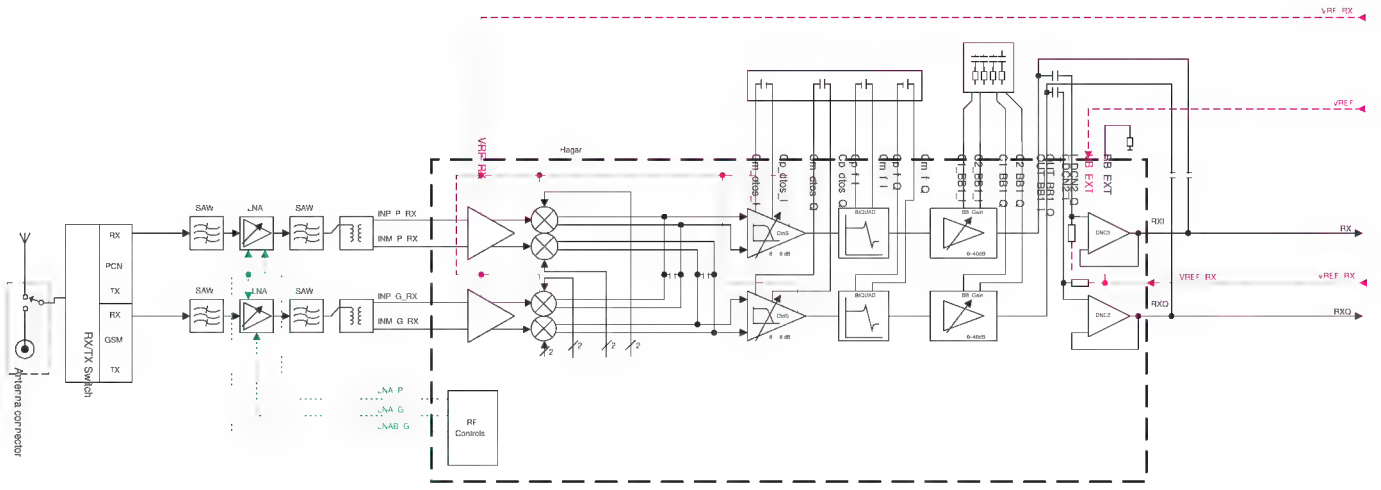


Figure 118.

5.1.3 RX/TX Switch

From the internal antenna connector (X499) the RF signal is lead to the RX/TX switch (Z670) via a mechanical switch, the antenna connector (X450).

The RX/TX switch is normally routing the signal to the two RX outlets GSM_Rx and DCS_Rx. If no control voltage is present at VC1 or VC2 the RX/TX switch will work as a diplexer and EGSM signals pass to GSM_Rx and PCN signals to DCS_Rx.

From GSM_Rx the EGSM signal is feed to the 1st EGSM SAW filter via C614.

5.1.4 Front end

The EGSM front–end consists mainly of two SAW filters (Z620 and Z600) and one discrete LNA circuit (V904) in–between and finally one balun (T600). The SAW filters provides out–of–band blocking immunity, the LNA provides front–end gain and the balun provides a balanced signal for Hagar (N505)

The signal–path is through Z620 (In–band insertion–loss 3,5dB), through the matching circuit (C613, Z612, Z613) and to the EGSM LNA transistor base (V700, RFin).

The LNA has about 20dB gain when it is on (LNA_G = 2.5V and Vlna=2.8V). If the signal applied to the antenna–connector is more than –45dBm the AGC will gainstep the LNA (LNA_G = 0V) which means the LNA Gain will now have negative gain (loss).

From the LNA transistor collector (V904 RF out) the signal is lead through the LNA–output–matching–circuit (R610, Z615, C610), through the 2nd EGSM SAW Z600 (In–band insertion–loss 3,5dB) to the EGSM balun T700. From the balun the signal is balanced and is lead to Hagar (N500 IMP_GSM_RX and INM_GSM_RX).

5.1.5 Hagar

The balanced RX signal is mixed with a signal from the local oscillator at the same frequency as the wanted RX signal. After mixing the signal is converted to a singleended signal in the DtoS (Differential to Singleended) amplifier. The signal is now filtered in a BIQUAD filter to provide channelseparation, amplified in the BB_Gain amplifier and DC compensated in DCN2.

5.2 PCN Receiver

General Instructions for troubleshooting

Connect the phone to a PC with a DAU–9P cable

Start Wintesla–Service–Software and

Select	Product		Alt+p
		Open…	
		RAE–3	
Select:	Product		Alt+p
	Band		b
		PCN	p
Select:	Testing		Alt+e
	RF Controls		r
	RX Continuous	Alt+r	
	Cont. Mode Ch:700	Alt+o, 700	
	AGC Absolute:	8	
	Multislot on	Alt+u, if on remove checkmark	

The set–up should now look like this (Figure 119):

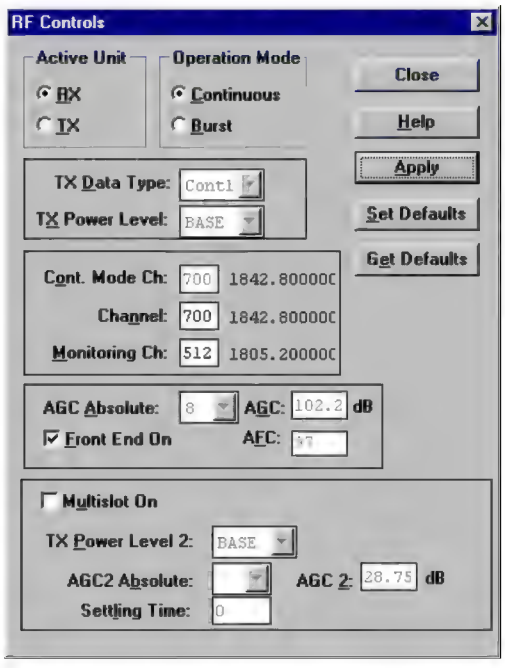


Figure 119.

Apply a 1842.867 MHz (channel 700 + 67.710kHz offset) –95dBm signal to the RF–connector (remember to compensate for cable attenuation).

Measuring with an oscilloscope on “Hagar RXI” or “Hagar RXQ” this picture should be seen on a working PCN receiver:

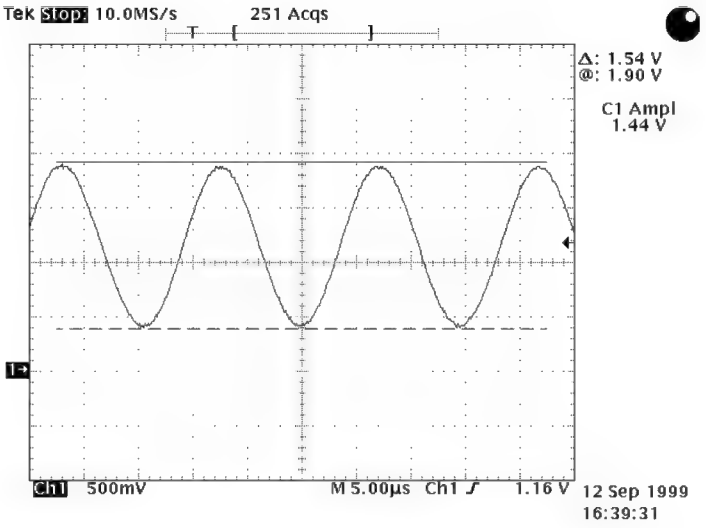


Figure 120.

Signal amplitude	350 mV p–p
DC offset	1,1V
Frequency	67kHz

If this picture is not seen, continue to the next section.

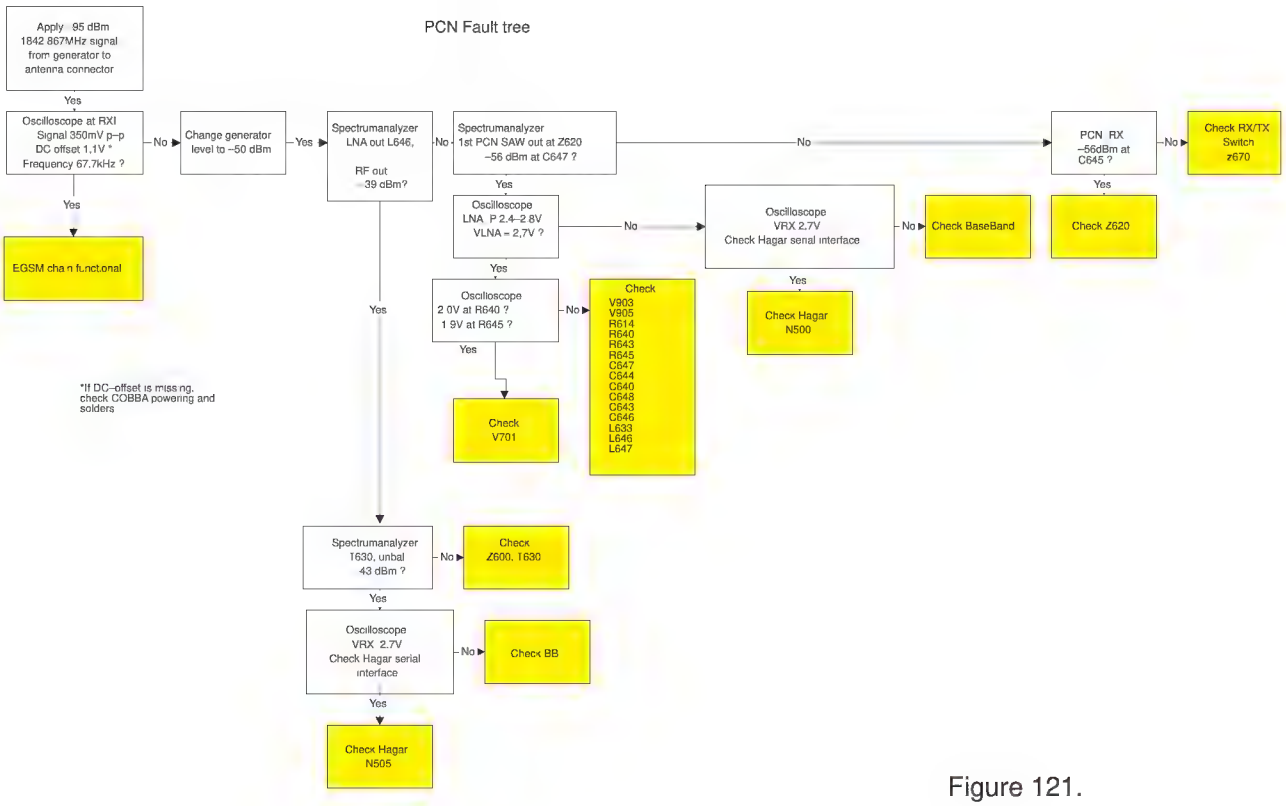

PCN Fault tree
Apply -85 dBm 1842.867MHz signal from generator to antenna connector
Yes
Oscilloscope at RXI Signal 350mV p-p DC offset 1,1V * Frequency 67.7kHz ?
No
Change generator level to -50 dBm
Yes
Spectrumanalyzer LNA out L646, RF out -39 dBm?
No
Spectrumanalyzer 1st PCN SAW out at Z620 -56 dBm at C647 ?
No
PCN RX -56dBm at C645 ?
No
Check RX/TX Switch z670
Yes
Check Z620
Yes
EGSM channel functional
*If DC-offset is missing, check COBBA powering and solders
Oscilloscope LNA_P 2.4-2.8V VLNA = 2,7V ?
No
Oscilloscope VRX 2,7V Check Hagar serial interface
No
Check BaseBand
Yes
Check Hagar N500
Oscilloscope 2.0V at R640 ? 1.9V at R645 ?
No
Check V903 V905 R614 R640 R643 R645 C647 C644 C640 C648 C643 C646 L633 L646 L647
Yes
Check V701
Spectrumanalyzer 1630, unbal -43 dBm ?
No
Check Z600, 1630
Yes
Oscilloscope VRX 2.7V Check Hagar serial interface
No
Check BB
Yes
Check Hagar N505

Figure 121.

5.2.1 PCN Signal Path

For easy error tracing it is important to know the signal path of the PCN receiver. The components can be grouped into blocks and drawn as shown below.

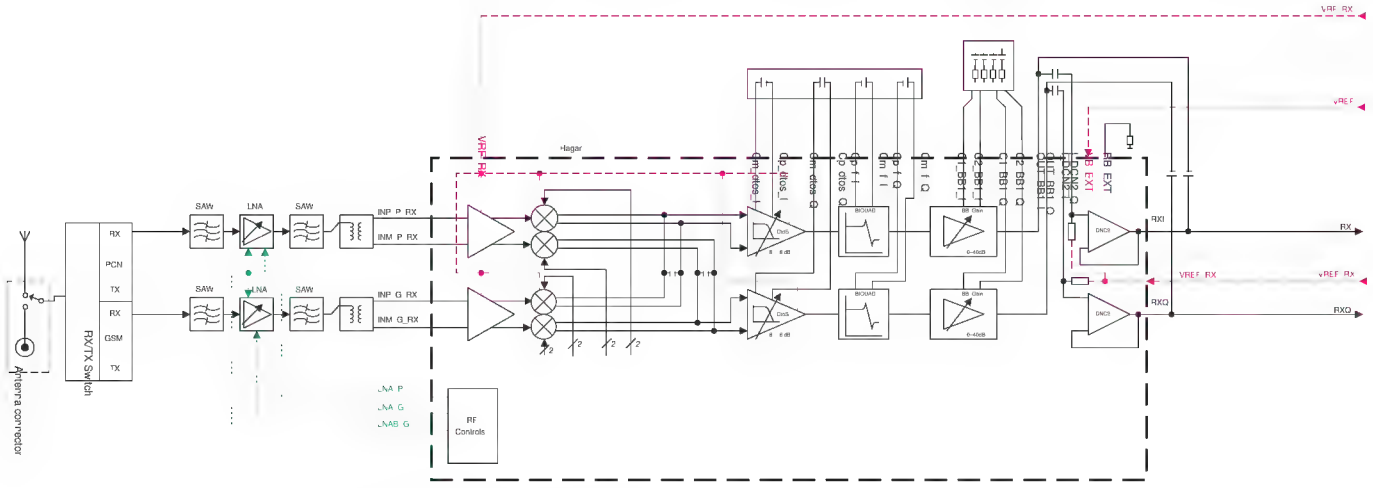


Figure 122. PCN RX signal path

5.2.2 RX/TX Switch

From the internal antenna connector (X499) the RF signal is lead to the RX/TX switch (Z670) via a mechanical switch, the antenna connector (X900).

The RX/TX switch is normally open to the two RX outlets GSM_Rx and DCS_Rx. If no control voltage is present at VC1 or VC2 the RX/TX switch will work as a diplexer and PCN signals pass to DCS_Rx and EGSM signals to GSM_Rx.

From DCS_Rx the PCN signal is feed to the 1st PCN SAW filter via C645.

5.2.3 Front end

The PCN front–end consists mainly of two SAW filters (Z620 and Z600) and one discrete LNA (V903) in–between and finally one balun (T630). The SAW filters provides out–of–band blocking immunity, the LNA provides front–end gain and the balun provides a balanced signal for Hagar (N505)

The signal–path is Through Z620 (In–band insertion–loss max 4dB), through the matching circuit (C674, C644, L647) and to the PCN LNA (V903, RFin).

The LNA has about 18 dB gain when it is on (LNA_P = 2.8V and Vlna=2.8V). If the signal applied to the antenna–connector is more than –45dBm the AGC will gainstep the LNA (LNA_P = 0V) which means the LNA Gain will now have negative gain (loss).

From the LNA transistor collector (V904 RF out) the signal is lead through the LNA–output–matching–circuit (R640, L633, C640, L646), through the 2nd PCN SAW Z600 (In–band insertion–loss max 4dB) through a matching–network (C720 and L706) and to the PCN balun T630. From the balun the signal is balanced and is lead to Hagar (N505 IMP_PCN_RX and INM_PCN_RX).

5.2.4 Hagar

The balanced RX signal is mixed with a signal from the local oscillator at the same frequency as the wanted RX signal. After mixing the signal is converted

to a single ended signal in the DtoS (Differential to Single ended) amplifier. The signal is now filtered in a BIQUAD filter to provide channel separation, amplified in the BB_Gain amplifier and DC compensated in DCN2.

5.3 EGSM Transmitter

General troubleshooting instructions

Apply a RF–cable to the RF–connector to allow the transmitted signal to act as normal. RF–cable should be connected to measurement equipment or to at least a 10–dB attenuator, otherwise the PA may be damaged.

Start Wintesla–Service–Software and

Select:	Product	Alt+p
	Band	b
	GSM	g
Select:	Testing	Alt+e
	RF Controls	r
	TX Power Level : BASE	Alt+x, b
TX Continuos	Alt+c	
	TX Data Type: Random	Alt+d, r
	Channel: 60	Alt+n, 60
	Apply	Alt+a

5.3.1 Path of transmitted EGSM signal

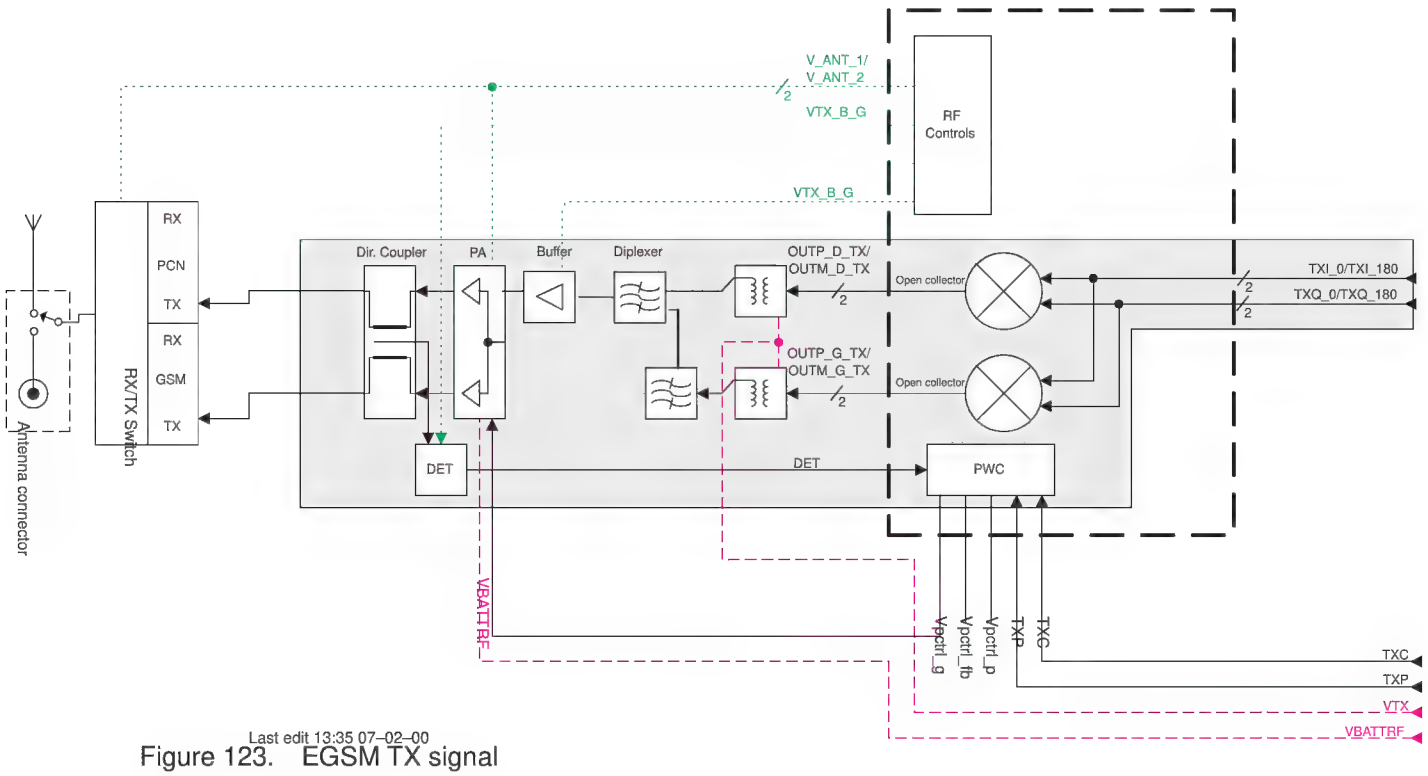


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Figure 123. EGSM TX signal

5.3.2 Troubleshooting diagram for EGSM Transmitter

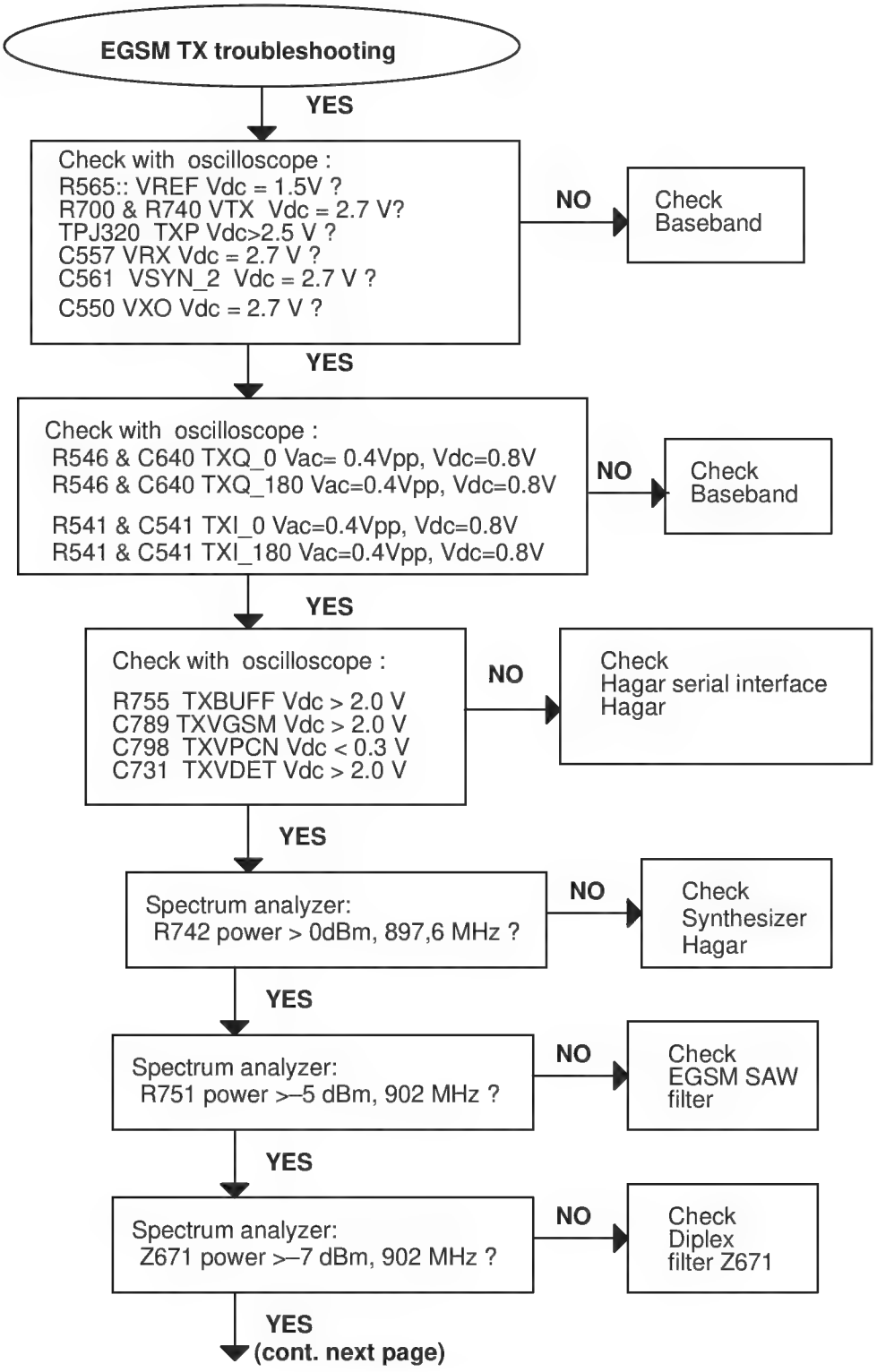

Figure 124.

(EGSM TX troubleshooting continued)

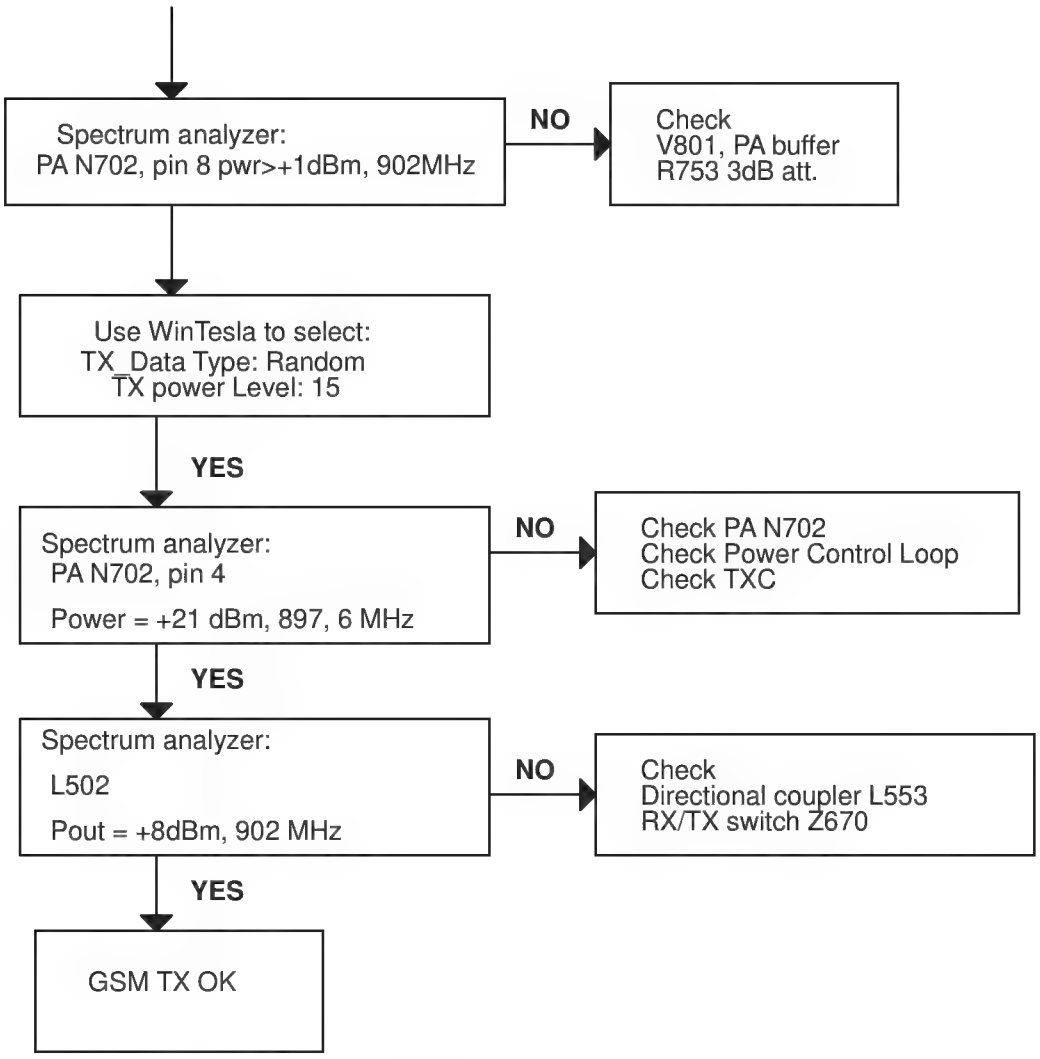

Figure 125.

5.4 PCN Transmitter

General troubleshooting instructions

Apply a RF–cable to the RF–connector to allow the transmitted signal to act as normal. RF–cable should be connected to measurement equipment or to at least a 10–dB attenuator, otherwise the PA may be damaged.

Start Wintesla–Service–Software and

Select:	Product	Alt+p
	Band	b
	PCN	p
Select:	Testing	Alt+e
	RF Controls	r
	TX Power Level: BASE	Alt+x, b
TX Continuos	.....	Alt+c
	TX Data Type: Random	Alt+d, r
	Channel: 700	Alt+n, 700
	Apply	Alt+a

5.4.1 Path of the transmitted PCN signal

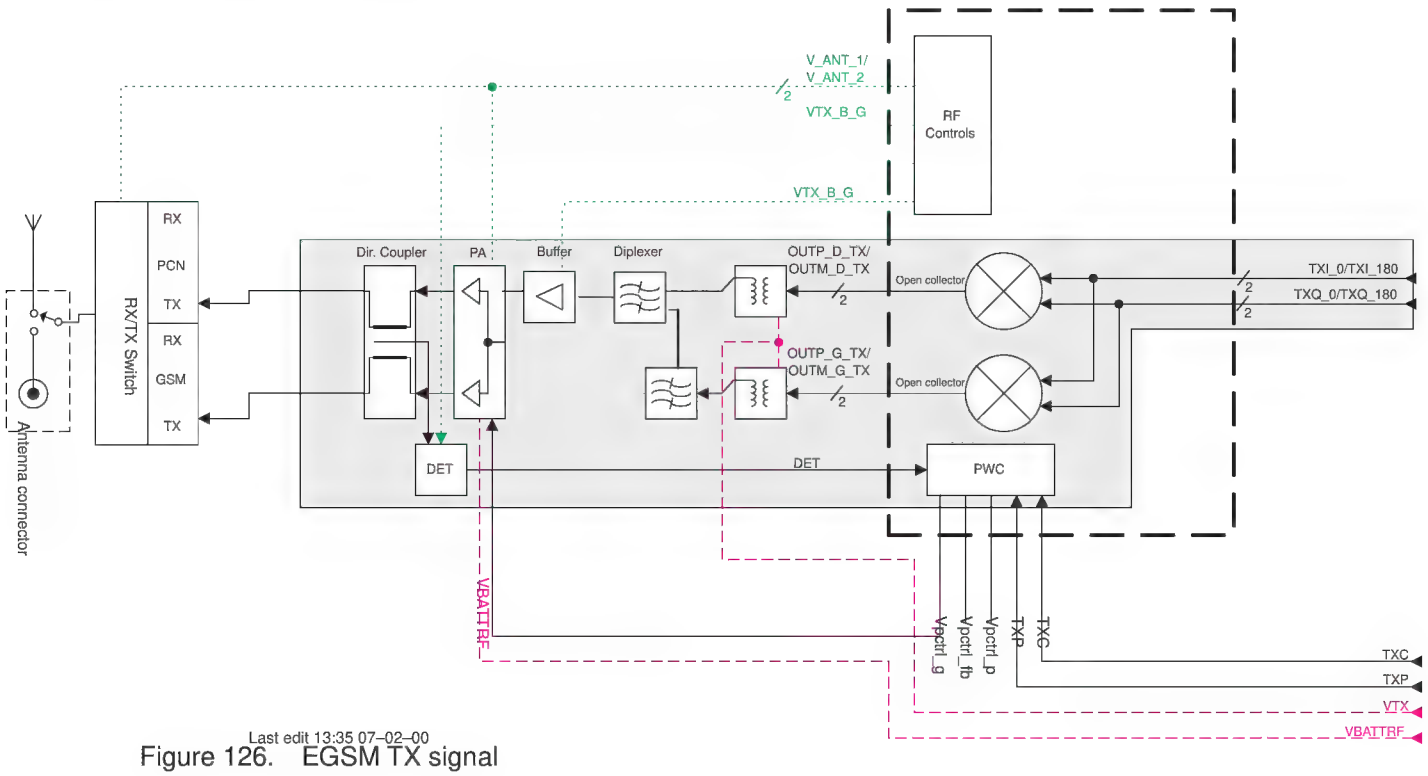

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Figure 126. EGSM TX signal

5.4.2 Troubleshooting diagram for PCN Transmitter

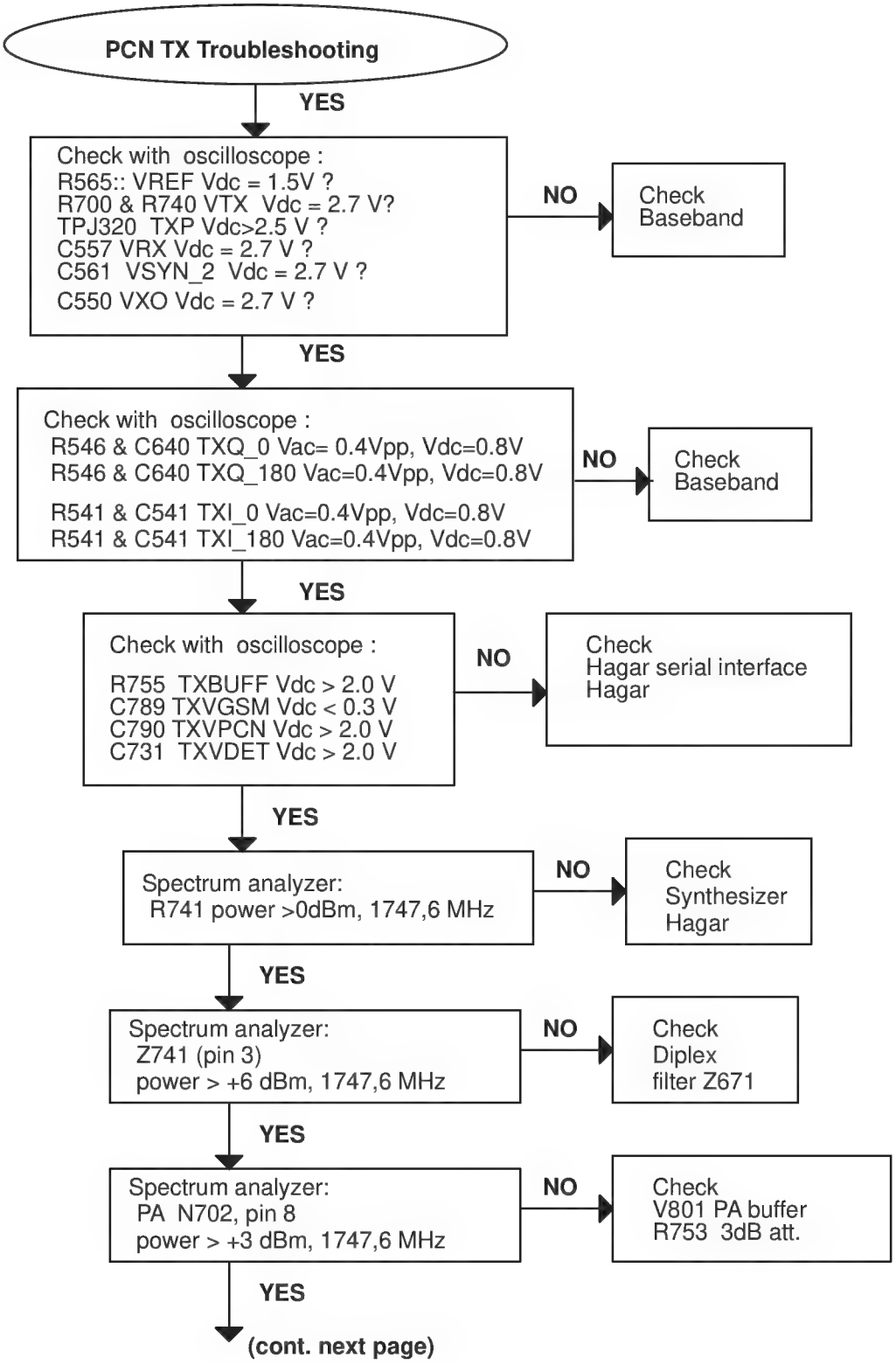


Figure 127.

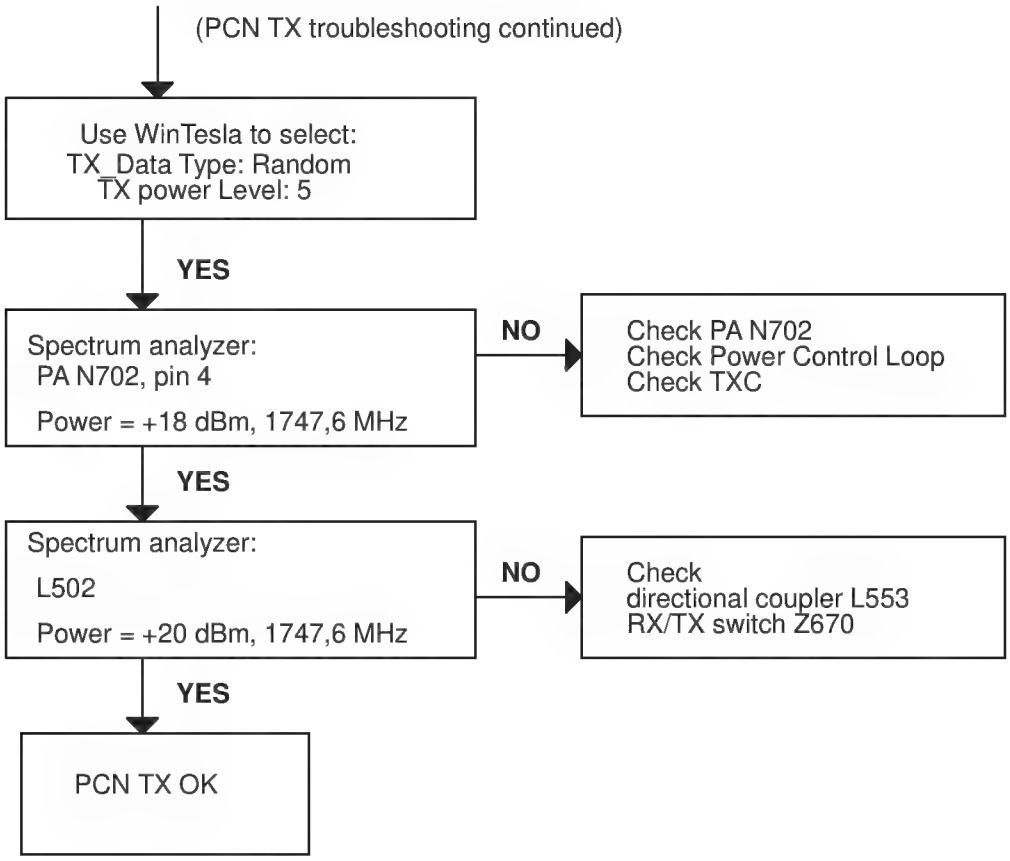

(PCN TX troubleshooting continued)
Use WinTesla to select:
TX_Data Type: Random
TX power Level: 5
YES
Spectrum analyzer:
PA N702, pin 4
Power = +18 dBm, 1747,6 MHz
NO
Check PA N702
Check Power Control Loop
Check TXC
YES
Spectrum analyzer:
L502
Power = +20 dBm, 1747,6 MHz
NO
Check
directional coupler L553
RX/TX switch Z670
YES
PCN TX OK

Figure 128.

5.5 Synthesizer

There is only one PLL synthesiser generating frequencies for both Rx and Tx in both bands (PCN and GSM). VCO frequency is divided by 2 or by 4 in HAGAR depending on which band is active.

General troubleshooting instructions

Start Wintesla–Service–Software and

Select:	Product		Alt+p
	Band		b
		EGSM	e
Select:	Testing		Alt+e
	RF Controls		r
		RX Continuous	Alt+r
		Cont. Mode Ch: 60	Alt+o, 60

In this situation there is possible to measure frequency of 3788 MHz at the output of the VCO (G600) using a spectrum analyzer.

5.5.1 26 MHz reference oscillator (VCTCXO)

The 26 MHz oscillator (G803) is used as a reference frequency for the PLL synthesiser and as the system clock for BB (13 MHz) after it is divided by 2 in HAGAR. 26 MHz signal from the VCTCXO is approx. 0,8 Vpp. Frequency of this oscillator is adjusted by dc voltage (Vcon) coming from the DAC in COBBA. Range of Vcon is 0.3 – 2.3 V.

5.5.2 VCO

The VCO is generating frequencies in the range of 3420 – 3840 MHz when PLL is in function. These are divided by 2 or by 4 in HAGAR so that they can generate all channels in GSM and PCN. Frequency of the VCO is controlled by dc voltage (Vc) coming from the loop filter. Range of the Vc when PLL is in function is 0.7 – 3.8 V. Even if PLL is not working (Vc out of range) there is some frequency at the output of the VCO (G600) which is between 3 and 4 GHz, ofcouse if the VCO is working.

5.5.3 Troubleshooting diagram for PLL Synthesizer

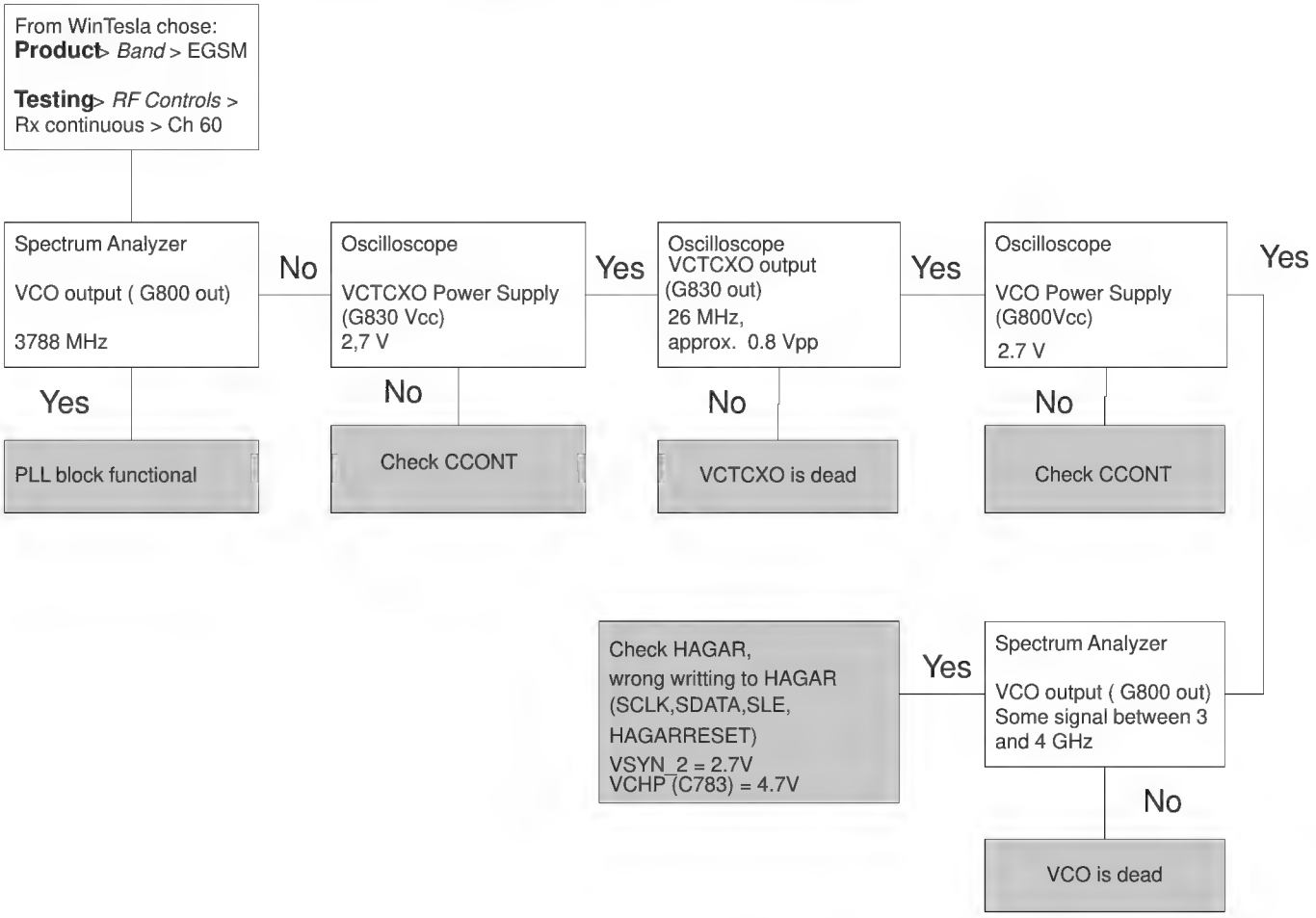


Figure 129.

It is important to say that power supply for VCTCXO (VXO) is OFF only in 'Deep Sleep Mode' and power supply for VCO (G800 Vcc) is OFF in 'Sleep Mode'.

If the phone goes 'dead' very short time after the power is turned ON, possible reason for this might be that 13 MHz system clock signal is not coming to the BB. Use the following chart to find the problem.

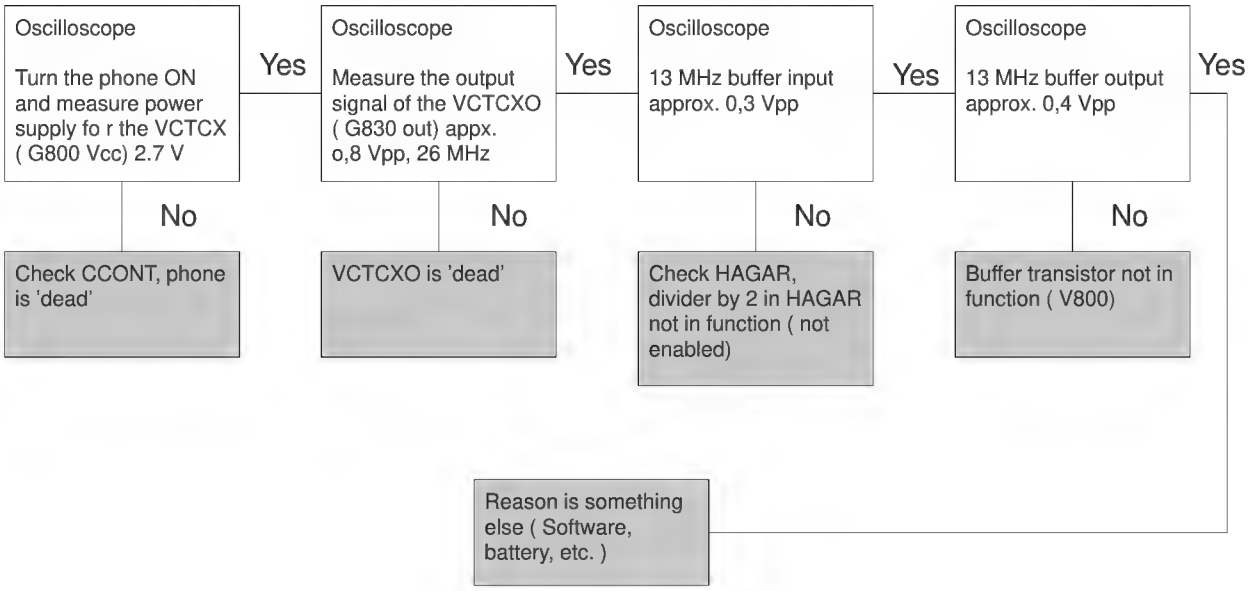
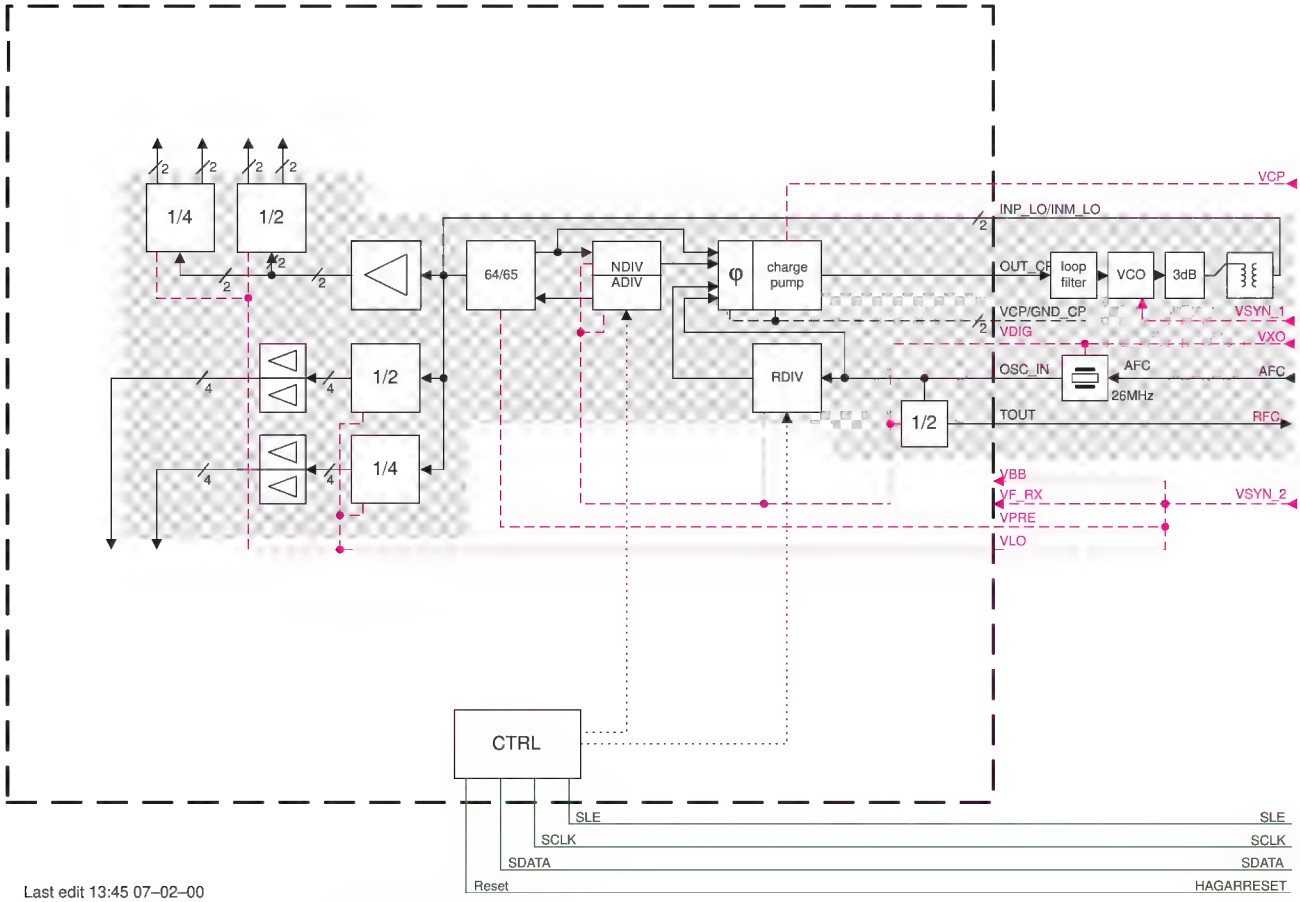

Oscilloscope
Turn the phone ON and measure power supply fo r the VCTCX (G800 Vcc) 2.7 V
Yes
Oscilloscope
Measure the output signal of the VCTCXO (G830 out) appx. o,8 Vpp, 26 MHz
Yes
Oscilloscope
13 MHz buffer input approx. 0,3 Vpp
Yes
Oscilloscope
13 MHz buffer output approx. 0,4 Vpp
Yes
No
Check CCONT, phone is 'dead'
No
VCTCXO is 'dead'
No
Check HAGAR, divider by 2 in HAGAR not in function (not enabled)
No
Buffer transistor not in function (V800)
Reason is something else (Software, battery, etc.)

Figure 130.

5.5.4 PLL Block Diagram



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Drawing12

Figure 131. PLL

5.6 Frequency lists

Table 6. PCN frequencies and corresponding VCO frequencies

CH	TX	vco	RX (TX+95)	VCO
512	1710.2	3420.4	1805.2	3610.4
513	1710.4	3420.8	1805.4	3610.8
514	1710.6	3421.2	1805.6	3611.2
515	1710.8	3421.6	1805.8	3611.6
516	1711.0	3422.0	1806.0	3612.0
517	1711.2	3422.4	1806.2	3612.4
518	1711.4	3422.8	1806.4	3612.8
519	1711.6	3423.2	1806.6	3613.2
520	1711.8	3423.6	1806.8	3613.6
521	1712.0	3424.0	1807.0	3614.0
522	1712.2	3424.4	1807.2	3614.4
523	1712.4	3424.8	1807.4	3614.8
524	1712.6	3425.2	1807.6	3615.2
525	1712.8	3425.6	1807.8	3615.6
526	1713.0	3426.0	1808.0	3616.0
527	1713.2	3426.4	1808.2	3616.4
528	1713.4	3426.8	1808.4	3616.8
529	1713.6	3427.2	1808.6	3617.2
530	1713.8	3427.6	1808.8	3617.6
531	1714.0	3428.0	1809.0	3618.0
532	1714.2	3428.4	1809.2	3618.4
533	1714.4	3428.8	1809.4	3618.8
534	1714.6	3429.2	1809.6	3619.2
535	1714.8	3429.6	1809.8	3619.6
536	1715.0	3430.0	1810.0	3620.0
537	1715.2	3430.4	1810.2	3620.4
538	1715.4	3430.8	1810.4	3620.8
539	1715.6	3431.2	1810.6	3621.2
540	1715.8	3431.6	1810.8	3621.6
541	1716.0	3432.0	1811.0	3622.0
542	1716.2	3432.4	1811.2	3622.4
543	1716.4	3432.8	1811.4	3622.8
544	1716.6	3433.2	1811.6	3623.2
545	1716.8	3433.6	1811.8	3623.6
546	1717.0	3434.0	1812.0	3624.0
547	1717.2	3434.4	1812.2	3624.4
548	1717.4	3434.8	1812.4	3624.8

CH	TX	vco	RX (TX+95)	VCO
549	1717.6	3435.2	1812.6	3625.2
550	1717.8	3435.6	1812.8	3625.6
551	1718.0	3436.0	1813.0	3626.0
552	1718.2	3436.4	1813.2	3626.4
553	1718.4	3436.8	1813.4	3626.8
554	1718.6	3437.2	1813.6	3627.2
555	1718.8	3437.6	1813.8	3627.6
556	1719.0	3438.0	1814.0	3628.0
557	1719.2	3438.4	1814.2	3628.4
558	1719.4	3438.8	1814.4	3628.8
559	1719.6	3439.2	1814.6	3629.2
560	1719.8	3439.6	1814.8	3629.6
561	1720.0	3440.0	1815.0	3630.0
562	1720.2	3440.4	1815.2	3630.4
563	1720.4	3440.8	1815.4	3630.8
564	1720.6	3441.2	1815.6	3631.2
565	1720.8	3441.6	1815.8	3631.6
566	1721.0	3442.0	1816.0	3632.0
567	1721.2	3442.4	1816.2	3632.4
568	1721.4	3442.8	1816.4	3632.8
569	1721.6	3443.2	1816.6	3633.2
570	1721.8	3443.6	1816.8	3633.6
571	1722.0	3444.0	1817.0	3634.0
572	1722.2	3444.4	1817.2	3634.4
573	1722.4	3444.8	1817.4	3634.8
574	1722.6	3445.2	1817.6	3635.2
575	1722.8	3445.6	1817.8	3635.6
576	1723.0	3446.0	1818.0	3636.0
577	1723.2	3446.4	1818.2	3636.4
578	1723.4	3446.8	1818.4	3636.8
579	1723.6	3447.2	1818.6	3637.2
580	1723.8	3447.6	1818.8	3637.6
581	1724.0	3448.0	1819.0	3638.0
582	1724.2	3448.4	1819.2	3638.4
583	1724.4	3448.8	1819.4	3638.8
584	1724.6	3449.2	1819.6	3639.2
585	1724.8	3449.6	1819.8	3639.6
586	1725.0	3450.0	1820.0	3640.0
587	1725.2	3450.4	1820.2	3640.4
588	1725.4	3450.8	1820.4	3640.8
589	1725.6	3451.2	1820.6	3641.2
590	1725.8	3451.6	1820.8	3641.6

CH	TX	vco	RX (TX+95)	VCO
591	1726.0	3452.0	1821.0	3642.0
592	1726.2	3452.4	1821.2	3642.4
593	1726.4	3452.8	1821.4	3642.8
594	1726.6	3453.2	1821.6	3643.2
595	1726.8	3453.6	1821.8	3643.6
596	1727.0	3454.0	1822.0	3644.0
597	1727.2	3454.4	1822.2	3644.4
598	1727.4	3454.8	1822.4	3644.8
599	1727.6	3455.2	1822.6	3645.2
600	1727.8	3455.6	1822.8	3645.6
601	1728.0	3456.0	1823.0	3646.0
602	1728.2	3456.4	1823.2	3646.4
603	1728.4	3456.8	1823.4	3646.8
604	1728.6	3457.2	1823.6	3647.2
605	1728.8	3457.6	1823.8	3647.6
606	1729.0	3458.0	1824.0	3648.0
607	1729.2	3458.4	1824.2	3648.4
608	1729.4	3458.8	1824.4	3648.8
609	1729.6	3459.2	1824.6	3649.2
610	1729.8	3459.6	1824.8	3649.6
611	1730.0	3460.0	1825.0	3650.0
612	1730.2	3460.4	1825.2	3650.4
613	1730.4	3460.8	1825.4	3650.8
614	1730.6	3461.2	1825.6	3651.2
615	1730.8	3461.6	1825.8	3651.6
616	1731.0	3462.0	1826.0	3652.0
617	1731.2	3462.4	1826.2	3652.4
618	1731.4	3462.8	1826.4	3652.8
619	1731.6	3463.2	1826.6	3653.2
620	1731.8	3463.6	1826.8	3653.6
621	1732.0	3464.0	1827.0	3654.0
622	1732.2	3464.4	1827.2	3654.4
623	1732.4	3464.8	1827.4	3654.8
624	1732.6	3465.2	1827.6	3655.2
625	1732.8	3465.6	1827.8	3655.6
626	1733.0	3466.0	1828.0	3656.0
627	1733.2	3466.4	1828.2	3656.4
628	1733.4	3466.8	1828.4	3656.8
629	1733.6	3467.2	1828.6	3657.2
630	1733.8	3467.6	1828.8	3657.6
631	1734.0	3468.0	1829.0	3658.0
632	1734.2	3468.4	1829.2	3658.4

CH	TX	vco	RX (TX+95)	VCO
633	1734.4	3468.8	1829.4	3658.8
634	1734.6	3469.2	1829.6	3659.2
635	1734.8	3469.6	1829.8	3659.6
636	1735.0	3470.0	1830.0	3660.0
637	1735.2	3470.4	1830.2	3660.4
638	1735.4	3470.8	1830.4	3660.8
639	1735.6	3471.2	1830.6	3661.2
640	1735.8	3471.6	1830.8	3661.6
641	1736.0	3472.0	1831.0	3662.0
642	1736.2	3472.4	1831.2	3662.4
643	1736.4	3472.8	1831.4	3662.8
644	1736.6	3473.2	1831.6	3663.2
645	1736.8	3473.6	1831.8	3663.6
646	1737.0	3474.0	1832.0	3664.0
647	1737.2	3474.4	1832.2	3664.4
648	1737.4	3474.8	1832.4	3664.8
649	1737.6	3475.2	1832.6	3665.2
650	1737.8	3475.6	1832.8	3665.6
651	1738.0	3476.0	1833.0	3666.0
652	1738.2	3476.4	1833.2	3666.4
653	1738.4	3476.8	1833.4	3666.8
654	1738.6	3477.2	1833.6	3667.2
655	1738.8	3477.6	1833.8	3667.6
656	1739.0	3478.0	1834.0	3668.0
657	1739.2	3478.4	1834.2	3668.4
658	1739.4	3478.8	1834.4	3668.8
659	1739.6	3479.2	1834.6	3669.2
660	1739.8	3479.6	1834.8	3669.6
661	1740.0	3480.0	1835.0	3670.0
662	1740.2	3480.4	1835.2	3670.4
663	1740.4	3480.8	1835.4	3670.8
664	1740.6	3481.2	1835.6	3671.2
665	1740.8	3481.6	1835.8	3671.6
666	1741.0	3482.0	1836.0	3672.0
667	1741.2	3482.4	1836.2	3672.4
668	1741.4	3482.8	1836.4	3672.8
669	1741.6	3483.2	1836.6	3673.2
670	1741.8	3483.6	1836.8	3673.6
671	1742.0	3484.0	1837.0	3674.0
672	1742.2	3484.4	1837.2	3674.4
673	1742.4	3484.8	1837.4	3674.8
674	1742.6	3485.2	1837.6	3675.2

CH	TX	vco	RX (TX+95)	VCO
675	1742.8	3485.6	1837.8	3675.6
676	1743.0	3486.0	1838.0	3676.0
677	1743.2	3486.4	1838.2	3676.4
678	1743.4	3486.8	1838.4	3676.8
679	1743.6	3487.2	1838.6	3677.2
680	1743.8	3487.6	1838.8	3677.6
681	1744.0	3488.0	1839.0	3678.0
682	1744.2	3488.4	1839.2	3678.4
683	1744.4	3488.8	1839.4	3678.8
684	1744.6	3489.2	1839.6	3679.2
685	1744.8	3489.6	1839.8	3679.6
686	1745.0	3490.0	1840.0	3680.0
687	1745.2	3490.4	1840.2	3680.4
688	1745.4	3490.8	1840.4	3680.8
689	1745.6	3491.2	1840.6	3681.2
690	1745.8	3491.6	1840.8	3681.6
691	1746.0	3492.0	1841.0	3682.0
692	1746.2	3492.4	1841.2	3682.4
693	1746.4	3492.8	1841.4	3682.8
694	1746.6	3493.2	1841.6	3683.2
695	1746.8	3493.6	1841.8	3683.6
696	1747.0	3494.0	1842.0	3684.0
697	1747.2	3494.4	1842.2	3684.4
698	1747.4	3494.8	1842.4	3684.8
699	1747.6	3495.2	1842.6	3685.2
700	1747.8	3495.6	1842.8	3685.6
701	1748.0	3496.0	1843.0	3686.0
702	1748.2	3496.4	1843.2	3686.4
703	1748.4	3496.8	1843.4	3686.8
704	1748.6	3497.2	1843.6	3687.2
705	1748.8	3497.6	1843.8	3687.6
706	1749.0	3498.0	1844.0	3688.0
707	1749.2	3498.4	1844.2	3688.4
708	1749.4	3498.8	1844.4	3688.8
709	1749.6	3499.2	1844.6	3689.2
710	1749.8	3499.6	1844.8	3689.6
711	1750.0	3500.0	1845.0	3690.0
712	1750.2	3500.4	1845.2	3690.4
713	1750.4	3500.8	1845.4	3690.8
714	1750.6	3501.2	1845.6	3691.2
715	1750.8	3501.6	1845.8	3691.6
716	1751.0	3502.0	1846.0	3692.0

CH	TX	vco	RX (TX+95)	VCO
717	1751.2	3502.4	1846.2	3692.4
718	1751.4	3502.8	1846.4	3692.8
719	1751.6	3503.2	1846.6	3693.2
720	1751.8	3503.6	1846.8	3693.6
721	1752.0	3504.0	1847.0	3694.0
722	1752.2	3504.4	1847.2	3694.4
723	1752.4	3504.8	1847.4	3694.8
724	1752.6	3505.2	1847.6	3695.2
725	1752.8	3505.6	1847.8	3695.6
726	1753.0	3506.0	1848.0	3696.0
727	1753.2	3506.4	1848.2	3696.4
728	1753.4	3506.8	1848.4	3696.8
729	1753.6	3507.2	1848.6	3697.2
730	1753.8	3507.6	1848.8	3697.6
731	1754.0	3508.0	1849.0	3698.0
732	1754.2	3508.4	1849.2	3698.4
733	1754.4	3508.8	1849.4	3698.8
734	1754.6	3509.2	1849.6	3699.2
735	1754.8	3509.6	1849.8	3699.6
736	1755.0	3510.0	1850.0	3700.0
737	1755.2	3510.4	1850.2	3700.4
738	1755.4	3510.8	1850.4	3700.8
739	1755.6	3511.2	1850.6	3701.2
740	1755.8	3511.6	1850.8	3701.6
741	1756.0	3512.0	1851.0	3702.0
742	1756.2	3512.4	1851.2	3702.4
743	1756.4	3512.8	1851.4	3702.8
744	1756.6	3513.2	1851.6	3703.2
745	1756.8	3513.6	1851.8	3703.6
746	1757.0	3514.0	1852.0	3704.0
747	1757.2	3514.4	1852.2	3704.4
748	1757.4	3514.8	1852.4	3704.8
749	1757.6	3515.2	1852.6	3705.2
750	1757.8	3515.6	1852.8	3705.6
751	1758.0	3516.0	1853.0	3706.0
752	1758.2	3516.4	1853.2	3706.4
753	1758.4	3516.8	1853.4	3706.8
754	1758.6	3517.2	1853.6	3707.2
755	1758.8	3517.6	1853.8	3707.6
756	1759.0	3518.0	1854.0	3708.0
757	1759.2	3518.4	1854.2	3708.4
758	1759.4	3518.8	1854.4	3708.8

CH	TX	vco	RX (TX+95)	VCO
759	1759.6	3519.2	1854.6	3709.2
760	1759.8	3519.6	1854.8	3709.6
761	1760.0	3520.0	1855.0	3710.0
762	1760.2	3520.4	1855.2	3710.4
763	1760.4	3520.8	1855.4	3710.8
764	1760.6	3521.2	1855.6	3711.2
765	1760.8	3521.6	1855.8	3711.6
766	1761.0	3522.0	1856.0	3712.0
767	1761.2	3522.4	1856.2	3712.4
768	1761.4	3522.8	1856.4	3712.8
769	1761.6	3523.2	1856.6	3713.2
770	1761.8	3523.6	1856.8	3713.6
771	1762.0	3524.0	1857.0	3714.0
772	1762.2	3524.4	1857.2	3714.4
773	1762.4	3524.8	1857.4	3714.8
774	1762.6	3525.2	1857.6	3715.2
775	1762.8	3525.6	1857.8	3715.6
776	1763.0	3526.0	1858.0	3716.0
777	1763.2	3526.4	1858.2	3716.4
778	1763.4	3526.8	1858.4	3716.8
779	1763.6	3527.2	1858.6	3717.2
780	1763.8	3527.6	1858.8	3717.6
781	1764.0	3528.0	1859.0	3718.0
782	1764.2	3528.4	1859.2	3718.4
783	1764.4	3528.8	1859.4	3718.8
784	1764.6	3529.2	1859.6	3719.2
785	1764.8	3529.6	1859.8	3719.6
786	1765.0	3530.0	1860.0	3720.0
787	1765.2	3530.4	1860.2	3720.4
788	1765.4	3530.8	1860.4	3720.8
789	1765.6	3531.2	1860.6	3721.2
790	1765.8	3531.6	1860.8	3721.6
791	1766.0	3532.0	1861.0	3722.0
792	1766.2	3532.4	1861.2	3722.4
793	1766.4	3532.8	1861.4	3722.8
794	1766.6	3533.2	1861.6	3723.2
795	1766.8	3533.6	1861.8	3723.6
796	1767.0	3534.0	1862.0	3724.0
797	1767.2	3534.4	1862.2	3724.4
798	1767.4	3534.8	1862.4	3724.8
799	1767.6	3535.2	1862.6	3725.2
800	1767.8	3535.6	1862.8	3725.6

CH	TX	vco	RX (TX+95)	VCO
801	1768.0	3536.0	1863.0	3726.0
802	1768.2	3536.4	1863.2	3726.4
803	1768.4	3536.8	1863.4	3726.8
804	1768.6	3537.2	1863.6	3727.2
805	1768.8	3537.6	1863.8	3727.6
806	1769.0	3538.0	1864.0	3728.0
807	1769.2	3538.4	1864.2	3728.4
808	1769.4	3538.8	1864.4	3728.8
809	1769.6	3539.2	1864.6	3729.2
810	1769.8	3539.6	1864.8	3729.6
811	1770.0	3540.0	1865.0	3730.0
812	1770.2	3540.4	1865.2	3730.4
813	1770.4	3540.8	1865.4	3730.8
814	1770.6	3541.2	1865.6	3731.2
815	1770.8	3541.6	1865.8	3731.6
816	1771.0	3542.0	1866.0	3732.0
817	1771.2	3542.4	1866.2	3732.4
818	1771.4	3542.8	1866.4	3732.8
819	1771.6	3543.2	1866.6	3733.2
820	1771.8	3543.6	1866.8	3733.6
821	1772.0	3544.0	1867.0	3734.0
822	1772.2	3544.4	1867.2	3734.4
823	1772.4	3544.8	1867.4	3734.8
824	1772.6	3545.2	1867.6	3735.2
825	1772.8	3545.6	1867.8	3735.6
826	1773.0	3546.0	1868.0	3736.0
827	1773.2	3546.4	1868.2	3736.4
828	1773.4	3546.8	1868.4	3736.8
829	1773.6	3547.2	1868.6	3737.2
830	1773.8	3547.6	1868.8	3737.6
831	1774.0	3548.0	1869.0	3738.0
832	1774.2	3548.4	1869.2	3738.4
833	1774.4	3548.8	1869.4	3738.8
834	1774.6	3549.2	1869.6	3739.2
835	1774.8	3549.6	1869.8	3739.6
836	1775.0	3550.0	1870.0	3740.0
837	1775.2	3550.4	1870.2	3740.4
838	1775.4	3550.8	1870.4	3740.8
839	1775.6	3551.2	1870.6	3741.2
840	1775.8	3551.6	1870.8	3741.6
841	1776.0	3552.0	1871.0	3742.0
842	1776.2	3552.4	1871.2	3742.4

CH	TX	vco	RX (TX+95)	VCO
843	1776.4	3552.8	1871.4	3742.8
844	1776.6	3553.2	1871.6	3743.2
845	1776.8	3553.6	1871.8	3743.6
846	1777.0	3554.0	1872.0	3744.0
847	1777.2	3554.4	1872.2	3744.4
848	1777.4	3554.8	1872.4	3744.8
849	1777.6	3555.2	1872.6	3745.2
850	1777.8	3555.6	1872.8	3745.6
851	1778.0	3556.0	1873.0	3746.0
852	1778.2	3556.4	1873.2	3746.4
853	1778.4	3556.8	1873.4	3746.8
854	1778.6	3557.2	1873.6	3747.2
855	1778.8	3557.6	1873.8	3747.6
856	1779.0	3558.0	1874.0	3748.0
857	1779.2	3558.4	1874.2	3748.4
858	1779.4	3558.8	1874.4	3748.8
859	1779.6	3559.2	1874.6	3749.2
860	1779.8	3559.6	1874.8	3749.6
861	1780.0	3560.0	1875.0	3750.0
862	1780.2	3560.4	1875.2	3750.4
863	1780.4	3560.8	1875.4	3750.8
864	1780.6	3561.2	1875.6	3751.2
865	1780.8	3561.6	1875.8	3751.6
866	1781.0	3562.0	1876.0	3752.0
867	1781.2	3562.4	1876.2	3752.4
868	1781.4	3562.8	1876.4	3752.8
869	1781.6	3563.2	1876.6	3753.2
870	1781.8	3563.6	1876.8	3753.6
871	1782.0	3564.0	1877.0	3754.0
872	1782.2	3564.4	1877.2	3754.4
873	1782.4	3564.8	1877.4	3754.8
874	1782.6	3565.2	1877.6	3755.2
875	1782.8	3565.6	1877.8	3755.6
876	1783.0	3566.0	1878.0	3756.0
877	1783.2	3566.4	1878.2	3756.4
878	1783.4	3566.8	1878.4	3756.8
879	1783.6	3567.2	1878.6	3757.2
880	1783.8	3567.6	1878.8	3757.6
881	1784.0	3568.0	1879.0	3758.0
882	1784.2	3568.4	1879.2	3758.4
883	1784.4	3568.8	1879.4	3758.8

CH	TX	vco	RX (TX+95)	VCO
884	1784.6	3569.2	1879.6	3759.2
885	1784.8	3569.6	1879.8	3759.6

Table 7. GSM frequencies and corresponding VCO frequencies

CH	TX	vco	RX (TX+95)	VCO
975	880.2	3520.8	925.2	3700.8
976	880.4	3521.6	925.4	3701.6
977	880.6	3522.4	925.6	3702.4
978	880.8	3523.2	925.8	3703.2
979	881.0	3524.0	926.0	3704.0
980	881.2	3524.8	926.2	3704.8
981	881.4	3525.6	926.4	3705.6
982	881.6	3526.4	926.6	3706.4
983	881.8	3527.2	926.8	3707.2
984	882.0	3528.0	927.0	3708.0
985	882.2	3528.8	927.2	3708.8
986	882.4	3529.6	927.4	3709.6
987	882.6	3530.4	927.6	3710.4
988	882.8	3531.2	927.8	3711.2
989	883.0	3532.0	928.0	3712.0
990	883.2	3532.8	928.2	3712.8
991	883.4	3533.6	928.4	3713.6
992	883.6	3534.4	928.6	3714.4
993	883.8	3535.2	928.8	3715.2
994	884.0	3536.0	929.0	3716.0
995	884.2	3536.8	929.2	3716.8
996	884.4	3537.6	929.4	3717.6
997	884.6	3538.4	929.6	3718.4
998	884.8	3539.2	929.8	3719.2
999	885.0	3540.0	930.0	3720.0
1000	885.2	3540.8	930.2	3720.8
1001	885.4	3541.6	930.4	3721.6
1002	885.6	3542.4	930.6	3722.4
1003	885.8	3543.2	930.8	3723.2
1004	886.0	3544.0	931.0	3724.0
1005	886.2	3544.8	931.2	3724.8
1006	886.4	3545.6	931.4	3725.6
1007	886.6	3546.4	931.6	3726.4
1008	886.8	3547.2	931.8	3727.2

Table 7. GSM frequencies and corresponding VCO frequencies

CH	TX	vco	RX (TX+95)	VCO
1009	887.0	3548.0	932.0	3728.0
1010	887.2	3548.8	932.2	3728.8
1011	887.4	3549.6	932.4	3729.6
1012	887.6	3550.4	932.6	3730.4
1013	887.8	3551.2	932.8	3731.2
1014	888.0	3552.0	933.0	3732.0
1015	888.2	3552.8	933.2	3732.8
1016	888.4	3553.6	933.4	3733.6
1017	888.6	3554.4	933.6	3734.4
1018	888.8	3555.2	933.8	3735.2
1019	889.0	3556.0	934.0	3736.0
1020	889.2	3556.8	934.2	3736.8
1021	889.4	3557.6	934.4	3737.6
1022	889.6	3558.4	934.6	3738.4
1023	889.8	3559.2	934.8	3739.2
0	890.0	3560.0	935.0	3740.0
1	890.2	3560.8	935.2	3740.8
2	890.4	3561.6	935.4	3741.6
3	890.6	3562.4	935.6	3742.4
4	890.8	3563.2	935.8	3743.2
5	891.0	3564.0	936.0	3744.0
6	891.2	3564.8	936.2	3744.8
7	891.4	3565.6	936.4	3745.6
8	891.6	3566.4	936.6	3746.4
9	891.8	3567.2	936.8	3747.2
10	892.0	3568.0	937.0	3748.0
11	892.2	3568.8	937.2	3748.8
12	892.4	3569.6	937.4	3749.6
13	892.6	3570.4	937.6	3750.4
14	892.8	3571.2	937.8	3751.2
15	893.0	3572.0	938.0	3752.0
16	893.2	3572.8	938.2	3752.8
17	893.4	3573.6	938.4	3753.6
18	893.6	3574.4	938.6	3754.4
19	893.8	3575.2	938.8	3755.2
20	894.0	3576.0	939.0	3756.0
21	894.2	3576.8	939.2	3756.8
22	894.4	3577.6	939.4	3757.6

Table 7. GSM frequencies and corresponding VCO frequencies

CH	TX	vco	RX (TX+95)	VCO
23	894.6	3578.4	939.6	3758.4
24	894.8	3579.2	939.8	3759.2
25	895.0	3580.0	940.0	3760.0
26	895.2	3580.8	940.2	3760.8
27	895.4	3581.6	940.4	3761.6
28	895.6	3582.4	940.6	3762.4
29	895.8	3583.2	940.8	3763.2
30	896.0	3584.0	941.0	3764.0
31	896.2	3584.8	941.2	3764.8
32	896.4	3585.6	941.4	3765.6
33	896.6	3586.4	941.6	3766.4
34	896.8	3587.2	941.8	3767.2
35	897.0	3588.0	942.0	3768.0
36	897.2	3588.8	942.2	3768.8
37	897.4	3589.6	942.4	3769.6
38	897.6	3590.4	942.6	3770.4
39	897.8	3591.2	942.8	3771.2
40	898.0	3592.0	943.0	3772.0
41	898.2	3592.8	943.2	3772.8
42	898.4	3593.6	943.4	3773.6
43	898.6	3594.4	943.6	3774.4
44	898.8	3595.2	943.8	3775.2
45	899.0	3596.0	944.0	3776.0
46	899.2	3596.8	944.2	3776.8
47	899.4	3597.6	944.4	3777.6
48	899.6	3598.4	944.6	3778.4
49	899.8	3599.2	944.8	3779.2
50	900.0	3600.0	945.0	3780.0
51	900.2	3600.8	945.2	3780.8
52	900.4	3601.6	945.4	3781.6
53	900.6	3602.4	945.6	3782.4
54	900.8	3603.2	945.8	3783.2
55	901.0	3604.0	946.0	3784.0
56	901.2	3604.8	946.2	3784.8
57	901.4	3605.6	946.4	3785.6
58	901.6	3606.4	946.6	3786.4
59	901.8	3607.2	946.8	3787.2
60	902.0	3608.0	947.0	3788.0

Table 7. GSM frequencies and corresponding VCO frequencies

CH	TX	vco	RX (TX+95)	VCO
61	902.2	3608.8	947.2	3788.8
62	902.4	3609.6	947.4	3789.6
63	902.6	3610.4	947.6	3790.4
64	902.8	3611.2	947.8	3791.2
65	903.0	3612.0	948.0	3792.0
66	903.2	3612.8	948.2	3792.8
67	903.4	3613.6	948.4	3793.6
68	903.6	3614.4	948.6	3794.4
69	903.8	3615.2	948.8	3795.2
70	904.0	3616.0	949.0	3796.0
71	904.2	3616.8	949.2	3796.8
72	904.4	3617.6	949.4	3797.6
73	904.6	3618.4	949.6	3798.4
74	904.8	3619.2	949.8	3799.2
75	905.0	3620.0	950.0	3800.0
76	905.2	3620.8	950.2	3800.8
77	905.4	3621.6	950.4	3801.6
78	905.6	3622.4	950.6	3802.4
79	905.8	3623.2	950.8	3803.2
80	906.0	3624.0	951.0	3804.0
81	906.2	3624.8	951.2	3804.8
82	906.4	3625.6	951.4	3805.6
83	906.6	3626.4	951.6	3806.4
84	906.8	3627.2	951.8	3807.2
85	907.0	3628.0	952.0	3808.0
86	907.2	3628.8	952.2	3808.8
87	907.4	3629.6	952.4	3809.6
88	907.6	3630.4	952.6	3810.4
89	907.8	3631.2	952.8	3811.2
90	908.0	3632.0	953.0	3812.0
91	908.2	3632.8	953.2	3812.8
92	908.4	3633.6	953.4	3813.6
93	908.6	3634.4	953.6	3814.4
94	908.8	3635.2	953.8	3815.2
95	909.0	3636.0	954.0	3816.0
96	909.2	3636.8	954.2	3816.8
97	909.4	3637.6	954.4	3817.6
98	909.6	3638.4	954.6	3818.4

Table 7. GSM frequencies and corresponding VCO frequencies

CH	TX	vco	RX (TX+95)	VCO
99	909.8	3639.2	954.8	3819.2
100	910.0	3640.0	955.0	3820.0
101	910.2	3640.8	955.2	3820.8
102	910.4	3641.6	955.4	3821.6
103	910.6	3642.4	955.6	3822.4
104	910.8	3643.2	955.8	3823.2
105	911.0	3644.0	956.0	3824.0
106	911.2	3644.8	956.2	3824.8
107	911.4	3645.6	956.4	3825.6
108	911.6	3646.4	956.6	3826.4
109	911.8	3647.2	956.8	3827.2
110	912.0	3648.0	957.0	3828.0
111	912.2	3648.8	957.2	3828.8
112	912.4	3649.6	957.4	3829.6
113	912.6	3650.4	957.6	3830.4
114	912.8	3651.2	957.8	3831.2
115	913.0	3652.0	958.0	3832.0
116	913.2	3652.8	958.2	3832.8
117	913.4	3653.6	958.4	3833.6
118	913.6	3654.4	958.6	3834.4
119	913.8	3655.2	958.8	3835.2
120	914.0	3656.0	959.0	3836.0
121	914.2	3656.8	959.2	3836.8
122	914.4	3657.6	959.4	3837.6
123	914.6	3658.4	959.6	3838.4
124	914.8	3659.2	959.8	3839.2

6 Diagrams of Test Points

Diagrams of test points are in a separate A3 document 09 Schematics.

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